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# The Madras Agricultural Journal

(ORGAN OF THE M. A. S. UNION)

Vol. XXXVI January 1949 No. 1

## *Editorial*

**Plant Protection:** In dealing with the food problem facing the country, emphasis has till recently been laid both by administrators and scientists on the aspects relating to increasing production by various means such as irrigation, application of fertilizers and introduction of improved varieties of crops. These are undoubtedly important aspects but it should not be forgotten that the losses in crop production caused by pests and diseases in the field and in storage are enormous and if timely and adequate steps are taken to reduce such losses the quantity of our available food supply would be increased considerably.

It is the realisation of this important aspect of the food problem in recent years that has led both the Central and Provincial Governments to pay increasing attention to the organisation of research and the strengthening of field staff, with a view to helping the cultivator in combating pests and diseases that affect his crops. A special Plant protection service to tackle problems on an All-India basis is functioning in New Delhi. In Madras, the organisation for plant protection has been strengthened recently, by the appointment of four plant protection officers for the Province and two plant protection assistants for each district. Provision has also been made, we understand, to supply the necessary fungicides, insecticides and spraying machinery to each district. We hope, that the cultivators would take full advantage of the plant protection organisation and seek its aid in combating the pests and diseases affecting their crops.

While the setting up of a plant protection service by Government is an important step, much yet remains to be done before the full benefit of the organisation is to be realised by the cultivators. Fungicides and insecticides are in short supply and spraying machinery suited to Indian conditions are not available. India is entirely dependent on foreign countries for the supply of spraying machinery and the cost of these appliances is often beyond the means of the

ordinary cultivator. Any measures taken to combat pests and diseases to be successful should cover the entire affected area and lack of means to cover large areas in a given time is one of the chief reasons why the methods sometimes fail to achieve the desired results.

It is time, therefore, that our industrialists turn their attention towards manufacture of spraying machinery and chemicals needed for Plant protection and we can assure them that a profitable future awaits those who embark on this enterprise.

**The use of Fertilizers:** We are glad that the Government of India are appointing an expert committee under the chairmanship of Dr. J. N. Mukerjee to go into the question of the use of fertilizers and organic manures, and submit their recommendation after an exhaustive enquiry and examination of relevant data that are available from the various Agricultural Research Stations in the country. While we do not wish to anticipate the findings of the expert committee we have no doubt in our own mind that considering the inadequacy of organic matter in most of our soils and the difficulty of replenishing it from outside due to limitations in our water supply, judicious use of fertilizers is one sure means of increasing our agricultural production. We are aware that virulent attacks on the practice of using fertilizers have been made in recent years and an attempt has been made to create a controversy where, in fact, there is none. No one claiming to be a scientific agriculturist minimises the importance of the value of organic manures. The careful conservation of organic refuse and their utilisation to the fullest possible extent are essential for crop production. But it should not be forgotten that the introduction of fertilizers about a century ago has led to enormous increase in food production throughout the world and if countries like America, Japan and Russia have trebled their acre yields of crops within the past few decades, the fact is attributable to a very great extent to the use of fertilizers.

We have ample evidence in this country that many crops benefit by the application of fertilizers and though here and there instances may be found of the adverse effects of *unbalanced* manuring it will be found on the study of evidence that proper balanced manuring has resulted in increased output.

The report of the expert committee will be eagerly awaited by all those interested in the agricultural progress of this country and we have no doubt that they will complete their task with expedition.

# More Sugar Per Acre

*By*

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I. **Introduction.** In any balanced system of food production, the production of sugar must form one of the important items. The demand and consumption of sugar is increasing and we are feeling more and more the deficiency of sugar in this Province, whose quota has to be supplemented from the other Provinces. Sugarcane cultivation is mainly confined to the tropical belt but in this country, its cultivation as well as the sugar industry is developed to a greater extent in the sub-tropical North India than in the tropical Southern Peninsula. Considering the favourable soil, climatic and varietal conditions for sugarcane in the Madras Province, the white sugar industry must be said to be still very backward when compared to the other Provinces as shown below :

**TABLE I.**

**Number of sugar factories working in 1944—'45, actual quantity of cane crushed, sugar produced and recovery per cent obtained.**

| Province. | No. of mills working. | Cane crushed (Tons) | Sugar (Tons) | Cane consumed in factories as % of total cane produced. | Sugarcane Recovery per cent. |
|---|---|---|---|---|---|
| United Provinces | 67 | 5,185,000 | 528,900 | 21·6 | 10·20 |
| Bihar | 29 | 1,588,600 | 169,900 | 30·9 | 10·69 |
| Madras | 11 | 510,400 | 46,500 | 6·0 | 9·11 |
| Bombay | 10 | 694,200 | 74,900 | 14·0 | 10·79 |

It is thus clear that to meet the demand and to make up the deficit of sugar in our Province an all-out drive for greater sugar production is essential and it is the object in this small note to make some suggestions for production of more sugar without increasing the area under sugarcane.

II. **Varietal.** One of the chief means by which improvement in sugar production is achieved is by the selection of better varieties than the ones in use. No doubt, our objective is to select high yielders coupled with high sugar content. Unfortunately few varieties combine those two qualities. The cultivator prefers to grow high-yielding varieties of cane, while the sugar manufacturer prefers high sugar varieties. Since our objective is "More sugar per acre" so as to increase the output per unit

area of land, the selection of varieties from the factory point of view should be on the basis of "more sugar per acre". Work done at Anakapalle has shown that varieties differ considerably as regards their sugar yield per acre.

**TABLE II.**

**Approximate amount of available sugar—Tons per acre.**

| Variety. | November. | | December. | | January. | | February. | | March. | | April. | | Yield of cane per acre |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sugar | C. C. S. | Sugar | C. C. S. | Sugar | C. C. S. | Sugar | C. C. S. | Sugar | C. C. S. | Sugar | C. C. S. | |
| Co 419 | 4·6 | 8·33 | 5·5 | 9·97 | 5.9 | 10·63 | 6·7 | 12·26 | 6·8 | 12·42 | 6·0 | 10·95 | 55 |
| Co 421 | 3·9 | 9·22 | 4·6 | 10·93 | 5·2 | 12·27 | 4·9 | 11·69 | 4·4 | 10·35 | 4·3 | 10·26 | 42 |
| Co 443 | 3·7 | 8·82 | 4·3 | 10·18 | 5·0 | 11·93 | 5·4 | 12·76 | 5·2 | 12·35 | 4·9 | 11·60 | 42 |
| Co 508 | 4·0 | 10·73 | 4·8 | 12·96 | 4·7 | 12·68 | 5·1 | 13.70 | 4·8 | 12·95 | 4·9 | 13·35 | 37 |
| Co 523 | 3·9 | 9·37 | 4·2 | 10·03 | 4·6 | 11·02 | 4·8 | 11·38 | 4·8 | 11·30 | 4·7 | 11·20 | 42 |
| Co 527 | 3·6 | 8·46 | 4·7 | 10·96 | 5·2 | 12·07 | 5·4 | 12·45 | 5·2 | 12·12 | 5·2 | 12·14 | 43 |
| POJ 2878 | 3·3 | 9·72 | 4·5 | 13·12 | 4·3 | 12·59 | 4·8 | 14·05 | 3·9 | 11·34 | 3·9 | 11·36 | 34 |

The data would show that varieties like POJ 2878, in spite of high CCS% cannot compete with Co 419 with respect to total sugar out-turn because of the lower yields. Certain varieties like Co 527 keep for a longer time than other varieties and can be crushed from December profitably taking the minimum C. C. S. requirement of sugar factories to be 10%.

In Table I, it was noted that the present recovery of sugar on cane in Madras is comparatively less than in Bombay and other Provinces. This may be partly due to immature canes being crushed by some of our factories. At least in the Madras Province, all the cultivators invariably take to Co 419 because of its high tonnage and its resistence to many unfavourable conditions. But, unfortunately, the cane is late-maturing and hence the recovery is poor in the initial stages. For the sugar factories to obtain higher recoveries and produce more sugar in unit time as also prolong their crushing period, they should take up the cultivation of varieties that give uniform recoveries and sucrose percentages for at least five months. Work at Anakapalle has shown that by crushing "Early", "Mid-season", and 'late' canes, the factories can prolong their crushing period and also get uniform recoveries for a longer time. Varieties Co 527 for early season, Co 449 for mid-season and Co 419 for late season have been recommended by this Station after much research on the basis of their ripening qualities as shown below:—

**TABLE III.**

**Juice quality of early, mid-season and late canes at Anakapalle.**

| Serial No. | Variety. | Nov. | | Dec. | | Jan. | | Feb. | | Mar. | | April | | May. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Suc % | Purity % | Suc % | Purity % | Suc % | Purity % | Suc % | Purity % | Suc % | Purity % | Suc % | Purity % | Suc % | Purity % | Remarks. |
| 1. | Co 527 | 13·36 | 82·77 | 17·39 | 86·50 | 17·61 | 87·34 | 18·06 | 88·80 | 18·34 | 91·73 | 17·29 | 83·66 | 17·37 | 86·32 | Early |
| 2. | Co 449 | 14·16 | 85·33 | 16·86 | 83·47 | 17·61 | 91·03 | 18·37 | 90·14 | 18·25 | 91·52 | 15·11 | 86·06 | ... | ... | Mid-season |
| 3. | Co 419 | 7·82 | 66·04 | 12·53 | 76·79 | 14·22 | 82·39 | 16·17 | 86·74 | 18·10 | 90·99 | 19·70 | 88·49 | 18·42 | 90·65 | Late. |

It would thus be clear that by a judicious crushing of early, mid-season and late canes, the factory economy can be increased and the out-turn of sugar considerably enhanced. But, unfortunately, the early and mid-season canes cannot compete with Co 419 as regards yield and to encourage the above varieties, a premium should be offered to compensate for the low yield. Ratoons mature earlier and hence the factories start crushing ratoons first. But this practice cannot altogether dispense with the need for 'early varieties' which would be suitable for crushing from Nov-Dec. onwards. Further, continuous ratooning is not conducive to increased tonnage of cane. Therefore, high-yielding and early maturing varieties must be encouraged in the factory areas by the offer of bonuses to off-set their lower yields.

III. **Manurial.** By careful and controlled manuring, increased yields of sugar can be realised. Of the plant-food elements, sugarcane responds most to nitrogen. Large applications of nitrogen especially in the form of Ammonium Sulphate and ground-nut cake in proportions of 2:1 or 1:1 have been tried in various Research Stations. In all these trials, one common conclusion is that while increasing doses of N may increase tonnage output of cane per acre, it delays maturity and may depress sucrose content also. The optimum dose, therefore, is one that gives increased yield per acre without delaying maturity or depressing sucrose content. In other words, maximum sugar per acre consistent with increased cost of manuring must be the criterion. This is illustrated by the data from the experiment on graded doses of N conducted at the Sugarcane Research Station, Gudiyatham.

(1945—'46.)

| Dose of Nitrogen lb. per acre. | Yield in tons per acre. | | Juice analysis at Harvest. | |
|---|---|---|---|---|
| | Cane | Sugar | Sucrose % | Purity. |
| 0 | 24·77 | 4·71 | 19·00 | 90·95 |
| 50 | 30·75 | 5·89 | 19·15 | 91·09 |
| 100 | 45·09 | 8·66 | 19·20 | 90·48 |
| 150 | 43·86 | 8·03 | 18·30 | 88·76 |
| 200 | 50·30 | 8·76 | 17·42 | 85·72 |
| 250 | 49·77 | 8·67 | 17·42 | 85·31 |

It is seen from the data that increased yields in tonnage of cane per acre beyond 100 lb. N, have not resulted in a proportionate increase in tonnage of sugar per acre. Experiments on the application of Nitrogen to sugarcane were reported from the Agricultural Research Stations, Anakapalle, Samalkotta, Gudiyatham and Palur. A perusal of the data shows that the northern and southern districts differ in their N requirements for sugarcane. From the available data it may be recommended that:—

(i) There is no significant increase in tonnage of cane between the dosage 100 lb. N to 200 lb. N in the Anakapalle and Samalkotta Farms.

(ii) At Gudiyatham, there is evidence for increase in tonnage of cane upto 200 lb. to 250 lb. N.

(iii) At Palur, there is increase in tonnage of cane even upto 250 lb. N and there may be response even to larger doses.

(iv) The delay in maturity and depression in sucrose %, starts at about 150 lb. N level at Anakapalle and Samalkotta, while it is about 150 lb. N at Gudiyatham and at about 200 lb. to 250 lb. N at Palur.

The available data are not sufficient to calculate available sugar per acre and hence critical levels for sucrose recovery cannot be fixed at present. In general it may be stated that a lower dose of N is desirable in a richer class of soils, and higher doses in poorer classes of soils in respect of tonnage, increase of cane, sucrose recovery and normal maturity.

IV. **Technical efficiency of factories.** No amount of improvement in yield and quality of cane can help in stepping up sugar production, if the efficiency of the factory is poor. Compared to other sugar-producing countries, the technical efficiency of Indian factories is low:

**TABLE**

**Efficiency of factories and recoveries in India as compared to other countries.**

| | India | Hawaii | Java | Formosa |
|---|---|---|---|---|
| Cane—Sucrose per cent | 12·18 | 11·95 | 13·22 | 13·30 |
| Cane—Fibre per cent | 16·18 | 13·44 | 12·60 | 12·60 |
| Mixed Juice | 80·45 | 82·38 | 84·30 | 85·30 |
| Extraction | 91·22 | 96·32 | 94·60 | 95·20 |
| Over-all recovery | 79·58 | 87·35 | 85·83 | 85·10 |
| Over-all recovery reduced technical efficiency | 85·04 | 89·44 | 86·36 | 84·92 |
| Yield per cent as Sugar | 9·74 | 10·74 | 11·16 | 11·48 |
| Yield per cent as Sugar (96 Pol) | 10·10 | 10·90 | ... | 11·80 |

(From N. L. Dutt's Report.)

The lower recovery in India as compared to Hawaii and Formosa cannot be attributed to poor juice quality as can be seen from the figures given below (from Dutt N. L. 1946.)

**TABLE**

**Juice analysis of varieties in India, Hawaii, Queensland and Natal**

| Particulars. | India. | | | | Hawaii. | | | |
|---|---|---|---|---|---|---|---|---|
| | Co 312 | Co 421 | Co 419 | Co 313 | K. 107 | D. 1135 | 31–1389 | H. 109 |
| Brix | 19·8 | 20·4 | 21·8 | 20·6 | 21·3 | 21·4 | 18·5 | 17·9 |
| Pol. | 18·3 | 17·9 | 20·3 | 18·2 | 18·3 | 18·2 | 15·5 | 15·4 |
| Purity | 92·5 | 87·9 | 93·1 | 88·4 | 85·9 | 84·9 | 83·9 | 85·1 |
| **Particulars.** | **Queensland.** | | | | **Natal.** | | | |
| | E. K 28 | Badilla | POJ.2878 | Co 281 | Co 290 | Co 301 | UBA | |
| Brix | 22·2 | 22·6 | 21·9 | 20·0 | 18·7 | 21·1 | 18·8 | |
| Pol | 20·3 | 20·8 | 19·9 | 18·2 | 16·4 | 19·3 | 16·4 | |
| Purity | 91·2 | 91·9 | 90·6 | 90·9 | 88·0 | 91·5 | 86·9 | |

The juice quality is as high as in the other sugar-producing countries and the defect must be attributed to the lower efficiency of the factory machinery. It is necessary that our factories are equipped with up-to-date machinery to improve the extraction as well as recovery. Dutt pointed out that average recovery in this country improved from 8.70 in 1934 to 9.72 in 1940 and of this, 82.35% is due to improvement in varieties and 17.65% is due to improvement in factory efficiency. Therefore, under the existing conditions, large improvements in recovery are possible if a proper varietal schedule is adopted.

V. **Summary.** Yield of cane and sugar per acre and the development of sugar industry as well as its present efficiency, are all capable of further improvement in this Province. Among the varieties now released from Anakapalle Sugarcane Research Station, Co 527 for early Co 449 for mid and Co 419 for late seasons are recommended. In regard to manuring it is pointed out that nitrogen is the most important. Beyond a particular dose, there is delay in maturity and depression in sucrose per cent. Therefore, the nitrogen level is to be judiciously fixed. The northern districts in general, require a lower level of nitrogen than the southern districts. India in general, and this province in particular, is poor in factory efficiency with poor sugar recovery. Due to current international and post-war restrictions, it would be difficult to renew the machinery. Therefore, the factories can resort to proper varietal schedules in order to improve their recovery per cent. By the above methods it is suggested that total output of sugar per acre can be increased.

VI. **Acknowledgment.** Our thanks are due to Sri R. Vasudevarao Naidu, Sugarcane Specialist, Anakapalle, for the keen interest evinced in the preparation of this note.

VII. **Literature.** Dutt N. L. (1946) Report on Survey of Sugarcane Research in India. Gandhi M. P. (1946) Indian Sugar Industry Annual. Madras Agricultural Station Reports 1935—'36 to 1947—'48 Thirumal Rao W. and Sriraman K. (1943) Commercial cane sugar value and its importance. M. A. J. XXXI. p. 317.

**Joss Sticks from Bagasse:—** Yoshi Twata, Tsuneo Jatsuno and Toe Shiang Wu. (pp. 100—103, 1947)—When bagasse is soaked for about two weeks in lime water it undergoes fermentation and chemical change and becomes moldable by machine to form sticks or coils, which when dried burn smoothly and produce an abundant smoke that has a repellant effect on mosquitoes. If the molded material is mixed with 10% of powdered dry leaves of essential oil-bearing plants (eucalyptus, citronella) the smoke is strongly repellant and largely fatal to mosquitoes. *(Sugar, Vol. 43, No. 7, July 1948, p. 49.)*

# A Note on Arrowing in Sugarcane Clumps

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Age of crop, seasonal phenomena, effect of environment, cultural and manurial treatments and influence of parent stock are some of the more important factors that affect flowering in sugarcane. Age of shoot and arrowing are positively correlated (6). Ratooning, is known to induce more arrowing (5). Increased doses of nitrogenous manures have a tendency to improve vegetative growth and retard flowering (4). Among environmental factors that have a bearing on arrowing, water-logging in the field is one (3) and the photo-period or the amount of light received by the cane clumps during their growth periods is another (1). For instance, in a trial laid out at the Sugarcane Breeding Station, Coimbatore, a majority of cane clumps receiving extra light were reported to have failed to flower. In an experiment with Co 421 at the Sugarcane Research Station, Anakapalle, during three successive years (1940–'41 to 1942–'43) arrowing in individual cane clumps was studied with reference to number of canes in each clump and the results of this study are presented in this paper.

2. **Material and Methods.** One thousand plants (primary shoots) were selected at random from a crop of Co 421, planted in rows 2'8" apart in March with single-budded setts at regular distances (10" between sett and sett along the row). It was thus possible to know that a particular shoot arose from a particular bud and demarcate the individual cane clumps clearly. Tillers arising from these plants till the end of August were marked at four-day intervals by labelling them as 1, 2, 3 and so on. Shoots coming up later on were removed as they were not likely to grow up to give useful canes by next February, the usual harvest time of Co 421 at this Station. The objective was to find out the correlation between age of shoot and arrowing and juice quality in Co 421 and the influence of shoot density on arrowing in cane clumps. In the second year of the experiment, there was practically no arrowing in this and many other varieties at Anakapalle due to uncongenial seasonal conditions. Hence the results of only 1940–'41 and 1942–'43 are considered in this paper.

Kashibuchi reported from Tainon, in Formosa "that differentiation in flower bud occurs by the end of September" (2). Co 421 usually completes flowering by the end of November at Anakapalle. Hence environmental and other factors will influence arrowing only if they are present before this period. Therefore to study the effect of the number of canes in a clump on arrowing (of canes) in the same, shoots living till the end of November in each of these thousand clumps were taken into account.

3. **Results and Conclusion.** Among the cane clumps studied (clumps were grouped according to the number of canes 1, 2, 3, etc. in each clump as shown in the table below) the percentage of arrowed cane clumps increased more or less progressively as the number of canes in each clump (shoot density) in the different groups increased. Results are presented in the following table :

| | 1940–'41 | | | 1942–'43 | | |
|---|---|---|---|---|---|---|
| No. of canes in each clump by the end of November. | No. of clumps having the different number of canes mentioned in column (1). | No. of clumps in column (2) with arrowed canes. | No. of arrowed clumps as a percentage of the total number of clumps with the same shoot density (col. 3 as % of col. 2.) | No. of clumps having the different number of canes mentioned in column (1). | No. of clumps in column (5) with arrowed canes. | No. of arrowed clumps as a percentage of the total number of clumps with the same shoot density. |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | 69 | 6 | 8·70 | 186 | 14 | 7·53 |
| 2 | 133 | 17 | 12·77 | 262 | 63 | 24·04 |
| 3 | 206 | 40 | 19.42 | 267 | 80 | 29·96 |
| 4 | 224 | 62 | 27·68 | 128 | 50 | 39·06 |
| 5 | 172 | 71 | 41·29 | 30 | 14 | 46·67 |
| 6 | 88 | 37 | 42·05 | 6 | 4 | 66·67 |
| 7 | 28 | 9 | 32·14 | ... | ... | ... |
| 8 | 9 | 6 | 66·67 | ... | ... | ... |
| 9 | 6 | 3 | 50·00 | ... | ... | ... |
| 10 | 2 | ... | ... | ... | ... | ... |
| 11 | ... | ... | ... | ... | ... | ... |
| 12 | 1 | ... | ... | ... | ... | ... |

N. B.— There was a high and significant positive correlation between shoot density in cane clumps and arrowing. The values of correlation coefficients for 1940–'41 and 1942–'43 were + 0·8979 ± 0·0646 and + 0·9822 ± 0·0144 respectively.

The results indicate that the factors that cause arrowing had a greater influence on the clumps with a higher shoot density than those with a fewer number of canes in each. Increase in the number of canes in a clump must have resulted in decreased nutrition to the individual shoots and as in the case of restricted manuring, induced flowering. Preliminary studies to test the applicability of this finding (that arrowing in cane clumps is positively correlated with their shoot density) in the case of two other varieties, Co 419 and Co 467, during 1946–'47 indicated substantial agreement with these results.

4. **Acknowledgment.** This paper was prepared while I was working at the Sugarcane Research Station, Anakapalle. My heart-felt thanks are due to the Superintendent of that Station who kindly gave me all facilities for work. My thanks are also due to the Indian Council of Agricultural Research who partly financed research work at this station during that period.

### 5. References.

(1) Annual report of the Imperial Sugarcane Expert (1938) for the period ending 30th June 1938.

(2) Kashibuchi. H. (1939) Review of report of the Sugar Experimental Station, Tainon, Formosa. No. 6 pp. 1–20. Original not seen. Extract from Facts about Sugar Vol. 34.

(3) Lakshmikantham M. (1945) Trial of Sugarcane varieties under swamp conditions in South India (A review). Madras Agrl. Jour. Vol XXXIII, Nos. 3 and 4. p-44.

(4) Lakshmikantham M. and Sankaran A. (1947) Optimum nitrogen requirement of Sugarcane in the Anakapalle tract. (Unpublished.)

(5) Vasudeva Rao Naidu R. and Lakshmikantham M. (1946) Ratooning Sugarcane in Madras. Madras Agricultural Journal Vol. XXXIV, Nos. 1, 2 & 3. p-5.

(6) Vasudeva Rao Naidu R. and Lakshmikantham M. (1946) Studies in tillering and arrowing in Co 421 at Anakapalle Indian Journal of Agricultural Science, Vol. XIV, Part II, pp. 139–151.

# Optimum Nitrogen Requirements of Sugarcane in the Anakapalle Tract

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I. **Introduction.** One of the main objects of sugarcane research at Anakapalle, is to draw up a manurial schedule for the tract in which the research station is situated. Earlier experiments on the problem on this station, indicated that nitrogenous manuring was a difinite necessity for sugarcane, while in the case of phosphatic and potassic manuring distinct advantages have not been secured. Attention was therefore concentrated on nitrogen, and to this end, an experiment with six levels of nitrogen with and with out a basal dressing of farmyard manure was conducted over a period of three years (1944–47) to study the influence of the different manurial doses on the yield, juice quality and economics of manuring, in respect of Co 419, the standard cane variety of the tract. The results of the experiment are presented in this paper.

II. **Material and Methods.** The experiment was laid out with six treatments, consisting of six levels of nitrogen (a) 0 lb. (b) 50 lb. (c) 100 lb. (d) 150 lb. and (f) 250 lb. of nitrogen per acre supplied in the form of groundnut cake, independently and in combination with a basal dressing of ten tons of farmyard manure per acre. The layout was in a split-plot design with four replications where farmyard manure and no farmyard manure constituted the two major treatments, while the six levels of nitrogen formed the minor treatments. The farmyard manure was applied fifteen days prior to planting and covered by working with ploughs. Analysis of this manure during 1945–46 and 1946–47 indicated that application at the rate of ten tons per acre was equivalent to 72·8 lb. and 86·5 lb. of nitrogen per acre in the two years respectively. The minor treatments were applied to the crop in two equal halves, one at the time of planting in March and the remainder at the time of trenching and earthing up in June. During the year 1944–'45 the experiment was laid out in wetlands but in the two subsequent years had to be accommodated on garden land. Germination, growth, arrowing, quality of juice and yields of cane and jaggery were the different items of study during the three years of experiment. The results obtained for each of three years separately are presented and discussed below.

III. **Results:** *(i) Germination.* In all the three years of the experiment the crop was planted by the middle of March with seed material

taken from a crop aged about seven months, as is usual on the station. The seed rate adopted was 15,000 three-budded sets per acre. Starting from the fifteenth day after planting, the extent of germination of the planted buds in the entire field was noted four times at weekly intervals. As such the influence of the major treatments and half the quantity of each of the different levels of nitrogen was reflected in the extent of germination in the respective treatments. The final germination percentages recorded five weeks after planting, are presented in Table I.

TABLE I.

**Effect of nitrogen levels on the percentage of germination**

| Treatments | Years 1944—45 | 1945—46 | 1946—47 | Average |
|---|---|---|---|---|
| **Minor Treatments.** | | | | |
| 0 lb. N F. Y. M. | 60 | 64 | 73 | 65·7 |
| No F. Y. M. | 59 | 65 | 73 | 65·7 |
| Average | 59·5 | 64·5 | 73·0 | 65·7 |
| 50 lb. N F. Y. M. | 62 | 64 | 74·0 | 66·7 |
| No F. Y. M. | 63 | 65 | 74 | 67·3 |
| Average | 62·5 | 64·5 | 74 | 67·0 |
| 100 lb. N F. Y. M. | 61 | 67 | 76 | 68·0 |
| No F. Y. M. | 64 | 70 | 76 | 70 0 |
| Average | 62·5 | 68·5 | 76·0 | 69.0 |
| 150 lb. N F. Y. M. | 62 | 65 | 77 | 68 0 |
| No F. Y. M. | 64 | 70 | 74 | 69·3 |
| Average | 63·0 | 67·5 | 75·5 | 68·7 |
| 200 lb. N F. M. M. | 61 | 67 | 77 | 68·3 |
| No F. Y. M. | 64 | 71 | 75 | 70·0 |
| Average | 62·5 | 69·0 | 76·0 | 69·2 |
| 250 lb. N F. Y. M. | 64 | 70 | 73 | 69·0 |
| No F. Y. M. | 63 | 69 | 75 | 69·0 |
| Average | 63·5 | 69·5 | 74·0 | 69·0 |
| S. E. of treatment Mean % | 1·63 | 2·06 | 1·70 | |
| C. D (P = 0·05) % | 4·71 | 5·94 | 4·92 | |
| **Major Treatments.** | | | | |
| F. Y. M. | 62 | 66 | 72 | 66·7 |
| No F. Y. M. | 61 | 68 | 71 | 66·7 |
| S. E. of treatment mean % | 1·52 | 0·80 | 0·90 | |
| C. D. (P= 0·05) % | 6·84 | 3·60 | 5·23 | |

Treatmental differences in minor as well as major treatments were not significant by 'Z' test in any of the three years.

The differences in germination percentage between the various treatments (major and minor) were found to be statistically not significant. Thus the findings of Rege and Sunnabhadti (1944) that a minimum of 15 lb. of nitrogen (when applied as sulphate of ammonia) per acre was necessary to ensure optimum germination was not borne out here. There was no doubt a slight improvement in germination due to manuring, but it was not statistically significant. From the stand point of

total germination, application of 50 lb. of nitrogen as groundnut cake at planting i. e., (100 lb. nitrogen treatment) was as good as 125 lb. nitrogen treatment i. e., (250 lb. nitrogen treatment).

(ii) *Growth.* Ten canes were selected at random from each sub-plot (40 canes from each treatment) and their height (from the base to the last visible leaf joint) measured from July to January every year. The average maximum and initial heights recorded in each year are furnished in Table II.

TABLE II.

**Average crop height in inches Co 419.**

| Nitrogen level lb. per acre. | Treatment. | 1944—45 | | 1945—46 | | 1946—47. | |
|---|---|---|---|---|---|---|---|
| | | July '44 | Jan '45 | July '45 | Jan '46 | July '46 | Jan '47 |
| **Minor :—** | | | | | | | |
| 0 | F. Y. M. | 48 | 123 | 54 | 134 | 44 | 140 |
| | No F. Y. M. | 52 | 129 | 53 | 136 | 44 | 134 |
| | Average | 50·0 | 126·0 | 53·5 | 135·0 | 44·0 | 137·0 |
| 50 | F. Y. M. | 57 | 146 | 60 | 144 | 49 | 142 |
| | No F. Y. M. | 53 | 138 | 55 | 142 | 45 | 140 |
| | Average | 55 | 142·0 | 57·5 | 143·0 | 47·0 | 141·0 |
| 100 | F. Y. M. | 56 | 151 | 63 | 150 | 50 | 147 |
| | No F. Y. M. | 55 | 150 | 61 | 151 | 50 | 146 |
| | Average | 55·5 | 150·5 | 62·0 | 150·5 | 50·0 | 146·5 |
| 150 | F. Y. M. | 58 | 147 | 63 | 146 | 49 | 148 |
| | No F. Y. M. | 54 | 147 | 61 | 149 | 51 | 140 |
| | Average | 56·0 | 147·0 | 62 0 | 147·5 | 50·0 | 144·0 |
| 200 | F. Y. M. | 56 | 151 | 65 | 149 | 55 | 149 |
| | No F. Y. M. | 59 | 147 | 65 | 152 | 50 | 146 |
| | Average | 57·5 | 149·0 | 65·0 | 150·5 | 52·5 | 147·5 |
| 250 | F. Y. M. | 57 | 151 | 66 | 149 | 49 | 146 |
| | No F. Y. M. | 57 | 146 | 64 | 147 | 44 | 142 |
| | Average | 57·0 | 148·5 | 65 | 148·0 | 46·5 | 144·0 |
| S. E. of treatment Mean % | | 1·39 | 2·33 | 1·73 | 1·94 | 2·60 | 2·57 |
| Critical Difference (P = 0 ·05) % | | 4·01 | 6·73 | 5·00 | 5·60 | 7·51 | 7·42 |
| **Major :—** | | | | | | | |
| F. Y. M. Series | | 55 | 145 | 74 | 145 | 48 | 155 |
| No F. Y. M. Series | | 55 | 143 | 72 | 146 | 47 | 141 |
| S. E. of treatment Mean % | | 0·854 | 1·40 | 1·08 | 0·74 | 1·38 | 0·33 |
| Critical Difference (P = 0·05) % | | 3·840 | 6·30 | 4·86 | 3·33 | 6·21 | 1·48 |

Statistical analysis of these data disclosed that differences due to minor treatments alone were significant during the first two years both with regard to initial and maximum heights. In the final year, however, only the differences between the major treatments were significant; and that too, with regard to maximum heights alone. There was an indication that farmyard manure had a beneficial effect on crop height, though it was not very marked in 1946–'47, when conditions were abnormal in that the rainfall from planting till the end of the grand period of vegetative growth was very low. It was only 22·09 inches, as against nearly twice this quantity received in the previous two years. The crop was kept alive by lift irrigation and farmyard manure plots probably retained more moisture and consequently promoted better growth than

in the "no farmyard manure" plots. Doses of nitrogen beyond 100 lb. per acre did not improve the average crop height. Fifty pounds of nitrogen was distinctly inferior to 100 lb. nitrogen treatment. There was no interaction between the major and minor treatments in any year.

Thus the general indication of these results was that manuring gave initial advantage in growth, prior to July or setting in of the South-West Monsoon. Afterwards, weather conditions rather than manuring must have influenced the growth of plants as was evidenced by the nonsignificance of the difference between the rates of growth recorded by major and minor treatments in two out of three seasons. These results agree with those recorded on this station and the Sugarcane Research Station, Gudiyatham, in the same year reported by Vasudeva Rao (1940). Carnelison A. H. and Cooper H. F. (1940) also reported, though in another context, that growth rate did not vary exclusively with variation in nitrogen treatments alone. Under their conditions temperature was the dominant factor determining the growth whatever be the amount of nitrogen supplied.

(iii) *Arrowing.* Co 419 does not flower freely at this station even in wet lands. On garden lands it does not flower at all. In this experiment there was arrowing in only one season (1944–1945) and the results are included in Table III below. Arrowing was suppressed in the higher nitrogen treatments (100 lb. nitrogen and over) and even in the lower levels the extent of arrowing decreased with an increase in the nitrogen level.

TABLE III.

**Extent of arrowing**

| Treatments | Percentage of arrowed to total number of stalks in the different treatments. |
|---|---|
| **Major.** | |
| No farmyard manure series ... ... ... | 6·13 |
| Farmyard manure series ... ... ... | 0·17 |
| **Minor.** | |
| 0 Lb. of Nitrogen ... ... ... | 5·75 |
| 50 lb. of Nitrogen ... ... ... | 0·56 |

There was no arrowing at all in the higher nitrogen levels

(iv) *Incidence of stem-borer.* To study the incidence of borer attack in relation to the different levels of nitrogenous manuring, 50 canes from each sub-plot and 200 canes in all for each treatment were examined. The percentage of canes and internodes affected by borers were determined in all the three years and the results are given in Table IV. From the data it is seen that the differences between the several treatments (major and minor) were statistically nonsignificant. Maximum borer attack was noted in the highest nitrogen treatment in two out of three years and this observation is in agreement with that reported by Dutt (1946).

TABLE IV.

**Percentage of canes affected by borer.**

| S. No. | Treatment. | 1944—45 | | 1945—46 | | 1946—47 | | Average of 3 years. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Canes. | Inter-nodes | Canes. | Inter-nodes. | Canes. | Inter-nodes. | Canes | Inter-nodes. |
| **Minor** | | | | | | | | | |
| 1. | 0 lb. N. | 42 | 5·43 | 86 | 8·10 | 36 | 1·98 | 56 | 5·17 |
| 2. | 50 lb. N. | 44 | 4·16 | 86 | 8·80 | 34 | 1·68 | 55 | 4·87 |
| 3. | 100 lb. N. | 46 | 4·32 | 80 | 7·82 | 36 | 2·11 | 54 | 4·75 |
| 4. | 150 lb. N. | 39 | 4·74 | 80 | 7·72 | 36 | 1·94 | 52 | 4·80 |
| 5. | 200 lb. N. | 36 | 5·59 | 72 | 5·03 | 40 | 2·03 | 49 | 4·22 |
| 6. | 250 lb. N. | 40 | 4·83 | 91 | 9·61 | 44 | 2·77 | 58 | 5·74 |
| S. E. of treatment Mean (%) | | | 11·74 | ... | ... | ... | 16·08 | ... | ... |
| C. D. (P = 0·05) % | | | 33·90 | ... | ... | ... | 46·30 | ... | ... |
| **Major** | | | | | | | | | |
| F. Y. M Series. | | ... | 4·60 | ... | ... | ... | 2·14 | ... | ... |
| No F. Y. M. Series | | ... | 5·11 | ... | ... | ... | 1·96 | ... | ... |
| S. E. of treatment Mean %. | | ... | 14·00 | ... | ... | ... | ... | ... | 2·30 |
| C. D. (P = 0·05) % | | ... | 63·03 | ... | ... | ... | ... | ... | 10·37 |

*N.B.*—Treatment differences were not significant by 'Z' test.

(v) *Juice quality.* Samples of cane juice from each of the treatments were analysed once a month from January till harvest each year. The results of chemical analysis recorded in March (the usual month of harvest of Co 419) for each of the three years separately are presented in Table V.

On an examination of the data presented in Table V, it is seen that the effect of the different treatments (major and minor) on juice quality was not consistent. In a majority of cases "no farmyard manure" series registered more brix, sucrose, purity and glucose values than the "farmyard manure" treatment. In the first year, when there was no lodging of the crop, the average values of sucrose for the different minor treatments progressively decreased with an increase in nitrogen level. In the next two years, the trend of the results was inconsistent, for the reason that there was extensive lodging of the crop and it affected the quality of the juice to varying degrees. However, in all the three seasons, 200 lb. and 250 lb. of nitrogen tended to record lower sucrose and purity values but higher glucose contents. The results are in general conformity with those recorded at the Agricultural Research Station, Palur (1941) of this Province and in Bombay as reported by Rege and Sunnabhadti (1941). That increased nitrogen fertilisation resulted in increased glucose contents in cane juice was also reported by Borden (1945) from Hawaii.

TABLE V.

**Results of chemical analysis of Juice, Co 419.**

| Nitrogen level lb. | Treatment. | Corrected Brix. | | | | Sucrose % | | | | Glucose % | | | | Purity % | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 44—45 | 45—46 | 46—47 | Av. | 44—45 | 45—46 | 46—47 | Av. | 44—45 | 45—46 | 46—47 | Av. | 44—45 | 45—46 | 46—47 | Av. |
| **Minor.** | | | | | | | | | | | | | | | | | |
| 0 lb. | F. Y. M. | 21·01 | 18·54 | 19·34 | 19·63 | 18·98 | 15·95 | 16 93 | 17·29 | 0·57 | 0·93 | 1·13 | 0·88 | 90·36 | 86 04 | 87·54 | 87·98 |
| | No F. Y. M. | 21·71 | 19·58 | 18·36 | 19·88 | 19·40 | 17·46 | 15·66 | 17·51 | 0·47 | 0·67 | 1·36 | 0·83 | 89 35 | 89 17 | 85·29 | 87 94 |
| | Average | 21·36 | 19.06 | 18·85 | 19·76 | 19·19 | 16·71 | 16·30 | 17·40 | 0·52 | 0·80 | 1·25 | 0·86 | 89·86 | 87 61 | 86·42 | 87·96 |
| 50 | F. Y. M. | 20·11 | 18·14 | 17·66 | 18·63 | 17·61 | 15·81 | 14·97 | 16·13 | 0·74 | 0·94 | 1·41 | 1·03 | 87·56 | 87·66 | 84·78 | 86·67 |
| | No F. Y. M. | 20·41 | 19·58 | 18·88 | 19·62 | 18·06 | 17·17 | 16·55 | 17·26 | 0·69 | 0·89 | 1·08 | 0·89 | 88·49 | 87·68 | 87·64 | 87·94 |
| | Average | 20·26 | 18·86 | 18·27 | 19·13 | 17·84 | 16·49 | 15·76 | 16·70 | 0·72 | 0 92 | 1·25 | 0·96 | 88·03 | 87·67 | 86·21 | 87·30 |
| 100 | F. Y. M. | 20·41 | 19·46 | 18·26 | 19.38 | 18·69 | 16·80 | 15·81 | 17 10 | 0·67 | 0·84 | 1·36 | 0·96 | 91 58 | 86·34 | 86·60 | 88·17 |
| | No F. Y. M. | 19·11 | 1·928 | 18·26 | 19·22 | 16·96 | 17·25 | 15·28 | 16·50 | 0·93 | 0·69 | 1·50 | 1·04 | 88·78 | 89·45 | 83·47 | 87 23 |
| | Average | 19·76 | 19·37 | 18·26 | 19·13 | 17·83 | 17·03 | 15·55 | 16·80 | 0·80 | 0·77 | 1·43 | 1·00 | 90·18 | 87·90 | 85·04 | 87·71 |
| 150 | F. Y. M. | 19·81 | 19·78 | 17·36 | 18·98 | 17·58 | 17·65 | 14·68 | 16·64 | 0·84 | 0·75 | 1·22 | 0·94 | 88·74 | 89·21 | 84·98 | 87·64 |
| | No F. Y. M. | 20·11 | 19·38 | 18·66 | 19·38 | 18·10 | 17·05 | 15·90 | 17 02 | 0·85 | 0·81 | 1·22 | 0·96 | 90·01 | 88·14 | 85·21 | 87·79 |
| | Average | 19·96 | 19·58 | 18·01 | 19·18 | 17 84 | 17·35 | 15·29 | 16·83 | 0·85 | 0·78 | 1·22 | 0·95 | 89 39 | 88·68 | 85·10 | 87·72 |
| 200 | F. Y. M. | 19·01 | 19·21 | 17·66 | 18·63 | 16·43 | 16·63 | 15·33 | 16·13 | 1·13 | 0·84 | 1·19 | 1·05 | 86·42 | 86·58 | 86·80 | 86 60 |
| | No F. Y. M. | 18·61 | 18.18 | 18·56 | 18·45 | 16·56 | 15·88 | 15·36 | 15·93 | 1·08 | 1·03 | 1·72 | 1·28 | 89 00 | 87·36 | 82 75 | 86·37 |
| | Average | 18 81 | 18·69 | 18·11 | 18·53 | 16·50 | 16·26 | 15·35 | 16·03 | 1 08 | 0·96 | 1·46 | 1·17 | 87·71 | 86·97 | 84·78 | 86·49 |
| 250 | F. Y. M. | 18·81 | 18·68 | 18·46 | 18·65 | 16·85 | 16·02 | 15·85 | 16·24 | 1·26 | 0 78 | 1·36 | 1·13 | 89·58 | 85·74 | 85·88 | 87·07 |
| | No F. Y. M. | 18·11 | 19·18 | 18·66 | 18·65 | 15·38 | 16·70 | 15 66 | 15·91 | 1·31 | 0·87 | 1·54 | 1·24 | 84·92 | 87 08 | 83·92 | 85·31 |
| | Average | 18·46 | 18·93 | 18·56 | 18·65 | 16·12 | 16·36 | 15·76 | 16·08 | 1·29 | 0·83 | 1·45 | 1·20 | 87 25 | 86·41 | 84·90 | 86·19 |
| **Major.** | | | | | | | | | | | | | | | | | |
| | F. Y. M. | 19·86 | 18·12 | 18 98 | 18·98 | 17·69 | 16·48 | 15·60 | 16·59 | 0·87 | 0 85 | 1·28 | 1·00 | 89·04 | 86·93 | 86·10 | 87·36 |
| | No F. Y. M. | 19·67 | 18·56 | 19·20 | 19·14 | 17·41 | 16·92 | 15·74 | 16·69 | 0·88 | 0 84 | 1·40 | 1·04 | 88·43 | 88·15 | 84·71 | 87·10 |

*N. B.*— (i) Percentages of each constituent on Juice weight are furnished.

(ii) Age of crop at the time of analysis was 354, 360, and 365 days in 1944—45, 45—46, and 46—47 respectively.

(vi) *Yield of cane.* The average yields of cane from the different treatments recorded in the three seasons are furnished in Table VI.

TABLE VI.

**Yield of cane in tons per acre.**

| | Treatments. | 1944—45 | 1945—46 | 1946—47 | Average for 3 years. |
|---|---|---|---|---|---|
| **Minor.** | | | | | |
| 0 lb. N | F. Y. M. | 35·16 | 44·62 | 44·36 | |
| | No F. Y. M. | 35·34 | 44·80 | 39·94 | |
| | Average | 35·25 | 44 71 | 42·15 | 40·70 |
| 50 lb. N | F. Y. M. | 51·11 | 49 70 | 49·09 | |
| | No F. Y. M. | 44·75 | 46·71 | 40·96 | |
| | Average | 47 93 | 48·21 | 45·03 | 47·06 |
| 100 lb. N | F. Y. M. | 52 30 | 53 53 | 53·14 | |
| | No F. Y. M. | 52 48 | 51·96 | 49 09 | |
| | Average | 52·39 | 52·70 | 51·12 | 52·07 |
| 150 lb. N | F. Y. M. | 55·60 | 45·95 | 47·78 | |
| | No F. Y. M. | 54·19 | 50·67 | 45·75 | |
| | Average | 54·90 | 48·31 | 46·77 | 49·99 |
| 200 lb. N | F. Y. M. | 52·95 | 44·92 | 49·71 | |
| | No F. Y. M. | 55·13 | 48 90 | 47·21 | |
| | Average | 54·04 | 46·91 | 48·46 | 49·80 |
| 250 lb, N | F. Y. M. | 57 88 | 47·35 | 50 46 | |
| | No F. Y. M. | 54·46 | 45·79 | 45·04 | |
| | Average | 56·17 | 46·57 | 47·75 | 50·16 |
| S. E. of treatment mean-tons | | 1·264 | 1·57 | 2·337 | |
| C. D. (P = 0·05) | | 3·649 | 4·53 | 6·749 | |
| **Major.** | F. Y. M. | 50·83 | 49·35 | 49·09 | |
| | No F. Y. M. | 49·35 | 48·14 | 45·00 | |
| S. E. of treatment mean-tons | | 1·255 | 0·378 | 1·273 | |
| C. D. (P = 0·05) | | 5 65 | 1·700 | 5·728 | |

The crop was harvested from 3rd to 23rd March, 17th April to 6th May and 17th March to 4th April in 1944—'45, 1945—'46 and 1946—'47 respectively. Although the farmyard manure series recorded higher yields, in general, there was no significant difference in yields due to major treatments. It was observed by Rege (1941) and Dutt (1946) that the influence of farmyard manure seemed to be more as a soil improver than as an effective supplier of plant food. But it was stressed that more elaborate and well-planned experiments were necessary to correctly assess the merit of this manure. This is borne out by the results of this experiment also. Among the minor treatments, treatment (f) 250 lb. N, gave the maximum yield in the first year (56·17 tons of cane per acre) but was statistically on a par with treatments (d) 150 lb. N and (e) 200 lb. N. Treatment (c) 100 lb. N recorded 52·39 tons of cane per acre and was fourth in order of merit. In the second year, treatment (c) 100 lb. N registered the highest yield of 52·70 tons of cane and was on a par with treatments (d) 150 lb. N and (b) 50 lb. N. In the final year the yield differences were not significant by 'Z' test. However, treatment (c) 100 lb. N, gave the maximum acre yield of 51·12 tons of cane. These results are at variance with those recorded at the Agricultural Research Station, Palur and Gudiyatham (1940) of this Province and by workers like Rege and Sunnabhadti (1944). But similiar results were recorded at the Agricultural Research Station, Samalkot (1940) where no significant

differences in yields were noticed between 100, 150 and 200 lb. nitrogen (per acre) treatments. Even at Shajahanpur (U. P.) in one experiment no significant differences between 100 and 200 lb. nitrogen treatments were noticed in two out of three years. This was reported by Rege (1941). In this connection, apart from the inherent fertility status of the soils, the influence of prevailing winds, usually common, in the East coast, should be taken into account. During 1944–'45 when there was practically no lodging, there was more or less a progressive increase in cane yields, with every increase in the nitrogen level. In 1945–'46 cyclonic winds prevailed in October followed by a flood and there was much damage due to lodging and breakage. During 1946–'47 also there was severe lodging and some breakage of canes. The crop under the treatments (c) to (f) which recorded practically similar maximum heights, seemed to have come in for a greater amount of damage than that in the lower nitrogen levels. Thus heavy lodging and breakage due to high winds in the higher nitrogen treatments seemed to be a contributory cause, apart from the inherent fertility status of soils, for the apparent inefficiency of treatments higher than 100 lb. nitrogen in increasing cane yields progressively. But one remarkable feature was the consistent performance of 100 lb. N, which recorded almost similar yields in all the three seasons, irrespective of the type of land and even under adverse seasonal conditions.

(vii) *Yield of jaggery.* Trial jaggery (Gur) boilings from each treatment were made once at harvest time each year. The percentage of gur on cane weight from the farmyard manure and no farmyard manure series in the different years are presented in Table VII.

TABLE VII.

**Yield of gur in tons per acre**

| Treatments | 1944—45 | 1945—46 | 1946—47 | Average for 3 seasons for both the major treatments. |
|---|---|---|---|---|
| **Minor.** | | | | |
| 0 lb. N F. Y. M. | 4·690 | 4·565 | 4·822 | |
| No F. Y. M. | 4·789 | 4·404 | 4·661 | |
| Average | 4·740 | 4·485 | 4·732 | 4·656 |
| 50 lb. N F. Y. M. | 5·975 | 4·697 | 4·801 | |
| No F. Y. M. | 5·929 | 4·545 | 5·112 | |
| Average | 5·952 | 4·621 | 4·957 | 5·177 |
| 100 lb. N F. Y. M. | 6·511 | 5·642 | 6·122 | |
| No F. Y. M. | 6·597 | 5·804 | 5·528 | |
| Average | 6·554 | 5·723 | 5·825 | 6·034 |
| 150 lb. N F. Y. M. | 6·699 | 4·926 | 5 055 | |
| No F. Y. M. | 6·828 | 5·837 | 4·689 | |
| Average | 6·764 | 5·382 | 4·872 | 5·673 |
| 200 lb. N F. Y. M. | 6·433 | 4·366 | 5·220 | |
| No F. Y. M. | 6·482 | 4·822 | 5·302 | |
| Average | 6·461 | 4·594 | 5·261 | 5·439 |
| 250 lb. N F. Y. M. | 7·304 | 4·323 | 5·364 | |
| No F. Y. M. | 6·219 | 4·620 | 5·081 | |
| Average | 6·762 | 4·472 | 5·233 | 5·486 |
| **Major.** | | | | |
| F. Y. M. | 6·269 | 4·753 | 5·231 | 5·417 |
| No F. Y. M | 6·142 | 5·005 | 5·062 | 5·403 |

The computed gur yields (based on gur recovery) from the different treatments are included in Table VIII.

TABLE VIII.

**Per cent jaggery recovery on cane weight.**

| Treatments | | 1944—45 | 1945—46 | 1946—47 | Average |
|---|---|---|---|---|---|
| **Minor.** | | | | | |
| 0 lb. N | F. Y. M. | 13·34 | 10·23 | 10·87 | 11·48 |
| | No F. Y. M. | 13·55 | 9·83 | 11·67 | 11·68 |
| | Average | 13·45 | 10·03 | 11·27 | 11·58 |
| 50 lb. N | F. Y. M. | 11·69 | 9·45 | 9·78 | 10·31 |
| | No F. Y. M. | 13·25 | 9·73 | 12·48 | 11·82 |
| | Average | 12·47 | 9·59 | 11·13 | 11·06 |
| 100 lb. N | F. Y. M. | 12·45 | 10·54 | 11·52 | 11·50 |
| | No F Y. M. | 12·57 | 11·17 | 11·26 | 11·67 |
| | Average | 12·51 | 10·86 | 11·39 | 11·59 |
| 150 lb. N | F Y. M. | 12·05 | 10·72 | 10·58 | 11·12 |
| | No F. Y. M. | 12·60 | 11·52 | 10·25 | 11·46 |
| | Average | 12·33 | 11·12 | 10·42 | 11·29 |
| 200 lb. N | F. Y. M. | 12·15 | 9·72 | 10·50 | 10·79 |
| | No F. Y. M. | 11·77 | 9·85 | 11·23 | 10·95 |
| | Average | 11·96 | 9·79 | 10·87 | 10·87 |
| 250 lb. N | F. Y. M. | 12·62 | 9·13 | 10·63 | 10·79 |
| | No F. Y. M. | 11·42 | 10·09 | 11·28 | 10·93 |
| | Average | 12·02 | 9·61 | 10·96 | 10·86 |
| **Major.** | | | | | |
| | F. Y. M. | 12·38 | 9·97 | 10·65 | 11·00 |
| | No F. Y. M. | 12·53 | 10·37 | 11·36 | 11·42 |

The data presented in Tables VII and VIII indicate that the farmyard manure series generally recorded lower jaggery recoveries. In 1944 – '45 the jaggery recovery was found to decrease with an increase in the nitrogen level, as in the case of juice quality. In the second year (1945 – '46) there was no definite trend in the recoveries. In the final year (1946 – '47) treatments (a) 0 lb. N, (b) 50 lb. N and (c) 100 lb. N, gave recoveries very nearly equal to each other and the remaining three treatments gave lower jaggery out-turns. The influence of the seasonal conditions which governed the juice quality was also reflected in the jaggery recovery values each year. Maximum jaggery yields were recorded by the treatment (d) 150 lb. N followed by (f) 250 lb. N and (c) 100 lb. N, in the first season and in the subsequent years 100 lb. N treatment (c) gave the highest gur yields.

(viii) *Relationship between yield (cane and gur) and nitrogen utilisation.* According to Borden (1944) who worked out the relationship between yields of cane and sugar and consumption of nitrogen by crops, 2·9 lb. of nitrogen per ton of cane and 7·9 lb. of nitrogen per month were necessary for producing a 40 to 49 ton crop grown over a period of 17·4 months at Hawaii. For 50 to 59 ton crop aged 18·3 months 2·6 lb. N per ton and 7·9 lb. N per month were necessary. At Anakapalle, the utilisation of nitrogen was more efficient as is evidenced by figures given below. The results in respect of treatment (c) 100 lb. Nitrogen alone are furnished, in Table IX.

TABLE IX.

**Nitrogen utilisation.**

| Season | Age of crop Months | Yield (tons) per acre | | Pounds of Nitrogen utilised per ton of | | per month |
|---|---|---|---|---|---|---|
| | | Cane | Gur | cane | Gur | |
| 1944—45 | 12·3 | 52·48 | 6·597 | 1·91 | 15·16 | 8 13 |
| 1945—46 | 13·2 | 51·96 | 5·804 | 1·92 | 17 23 | 7·58 |
| 1946—47 | 12·6 | 49·09 | 5·528 | 2·04 | 18·09 | 7·94 |

(ix) *Economics of manuring*. The cost of production per ton of cane in the different manurial treatments is presented in Table X. The lowest production costs were recorded by the treatment (c) 100 lb. N in both the farmyard manure and no farmyard manure treatments, except in one instance.

TABLE X.

**Cost of production per ton of cane**

| Treatment Lb. N. | 1944—1945 | | 1945—1946 | | 1946—1947 | |
|---|---|---|---|---|---|---|
| | F. Y. M. Rs. | No F. Y. M. Rs. | F. Y. M, Rs. | No F. Y. M. Rs. | F. Y. M. Rs. | No F. Y. M Rs. |
| (a) 0 N | 15·41 | 13·26 | 22 89 | 21·66 | 25·22 | 26·30 |
| (b) 50 | 13·55 | 12·60 | 21·81 | 21·31 | 23·88 | 26·48 |
| (c) 100 | 13·73 | 12·29 | 20·92 | 19·80 | 23 42 | 24·00 |
| (d) 150 | 13·69 | 12·46 | 23·96 | 21·02 | 26 06 | 26 00 |
| (e) 200 | 14·24 | 12·67 | 25·12 | 27·43 | 25 83 | 25·96 |
| (f) 250 | 14·03 | 13·01 | 24·66 | 23·44 | 26·10 | 27·60 |

IV. **Summary and conclusions.** With a view to determine the *optimum nitrogen requirement of sugarcane in the Anakapalle tract*, an experiment involving two major treatments (ten tons of farmyard manure per acre and no farmyard manure) and six minor treatments, (0 lb., 50 lb., 100 lb., 150 lb., 200 lb. and 250 lb. of nitrogen per acre) supplied in the form of groundnut cake was conducted over a period of three years in succession, 1944–'45 to '46–47. The variety of cane planted was Co 419. The results of the experiment indicate the following conclusions :

1. Application of farmyard manure did not influence the different phases of crop performance to any appreciable extent though the general indication was that it had some favourable effect. Under extreme conditions of drought its beneficial influence was more pronounced.

2. No significant effect of manures was noticed on germination of buds.

3. There was significant difference in growth due to minor treatments. Treatments (c) 100 lb. N and (f) 250 lb. N recorded almost similar heights. The rates of growth in the different treatments did not differ significantly among themselves.

4. Influence of manuring on the incidence of stem-borer was not significant.

5. The higher nitrogen treatments (e) 200 lb. N and (f) 250 lb. N yielded poor quality juice.

6. The maximum average yields of cane and gur were recorded by the treatment 100 lb. N (c), and the cost of production in this treatment was at a minimum.

7. From the point of yield, as well as cost of production per unit weight of cane , 100 lb. Nitrogen per acre, was found to be the optimum for sugarcane in this tract when applied in the form of groundnut cake.

**Acknowledgments.** The writers take this opportunity of acknowledging their indebtedness to Sri N. L. DUTT. M. SC., F. A. SC., Government Sugarcane Expert, Coimbatore, for his constructive criticism and valuable suggestions on this paper. To the Superintendent, Sugarcane Research Station, Anakapalle, the authors feel very grateful for all the facilities afforded and encouragement given throughout the conduct of the experiment. The studies embodied in this paper formed part of a Scheme of Research on Sugarcane financed by the Indian Council of Agricultural Research. The Councils' grant is gratefully acknowledged.

## REFERENCES.

1. Agricultural Research Station Reports (Madras Presidency) — 1940–41. pp. 271 and 734
2. Borden R. (1944) — Hawa Planter's Rec. Vol. '48–2 pp. 65–72. Original not seen. Extract from Sugar Vol. 39, No. 11.
3. Do. do. (1945) — Hawa Planter's Rec. Vol. 49. Nos. 3 & 4, pp. 259–312.
4. Carnelison A. H. and Cooper H. P. (1940) — Hawa Planter's Rec. Vol. 44.
5. Dutt N. L. (1946) — Report on the Survey of Sugarcane Research in India. pp. 102 & 109
6. Rege R. D. (1941) — Misc. Bull. No. 41, I. C. A. R. pp. 31 and 51
7. Do. do. and Sunnabhadti S. K. (1941) — Proc. 10th Conv. Sugar Tech. Assoc. India. 1941 pp. 71–85
8. Do. do. (1944) — Ind. J. Agri. Sci. Vol. 14, Part 1, pp. 1–18
9. Vasudeva Rao R. (1940) — Agri. Res. Stn. Reports Madras. pp. 4 and 72.

# Some Observations on the Spread and Decline of Sugarcane Varieties in Madras, during the last fifty years

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Several cane varieties which were once the mainstay of the sugar and '*gur*' industry of this Province have either gone out of existence altogether or are now retained only in small-scale varietal collection plots on Research Stations. Some of these varieties occupied large areas for a comparatively long period while others could retain their importance only for a short period. This was due to several causes, natural, and artificial. It is proposed to present in this paper a historical review of the rise and fall of the important cane varieties till now cultivated on a large scale in this Presidency and to discuss the causes responsible for their replacement. Incidentally, the question, whether sugarcane varieties deteriorate in the physiological or genetic sense of the word is also dealt with here. The yield and other data from the Sugarcane Research Station, Anakapalle, are furnished for purposes of illustration.

It may be mentioned that unlike in other countries (6) the areas under different varieties in this Province are mere estimates. Only these approximate figures are avilable for judging the spread of varieties.

2. **Historical.** In the late nineties of the last century, when cane cultivation was not as extensive as at present, there was a furore in the East Godavari District that varieties under cultivation deteriorated and died extensively and that immediate Government aid was necessary to rehabilitate them. Dr. Barber, the then Government Botanist went into the matter and declared the cause of the failure of the crop to be due to the disease, Red Rot. It was then felt that among the steps to be taken to stem the tide of this and other diseases, the breeding of hardy hybrid canes suitable for the different tracts in this country was one of the foremost. After the establishment of the Sugarcane Breeding Station at Coimbatore in 1912, a stream of cane seedlings flooded the country. By selective breeding and introduction of the blood of wild ancestors like *Saccharum Spontaneum*, drought and disease resistance were introduced in the cane seedlings. Prior to the popularisation and spread of the seedlings i. e., till 1927, Purple Mauritius, J. 247, B. 208 and Java-Hebbal in the East-Godavari District, J. 247, B. 208 and Java-Hebbal in the Vizagapatam District, Striped and Ashy Mauritius, *Tellacheruku* and J. 247 in the North Arcot District, POJ 2878, J. 247 and Fiji B or Badilla in the

South Arcot District, 'Hotta Kabbu' 'Javari Kabbu' and 'Hullu Kabbu' in the Bellary District, were under extensive cultivation. Cultivation of Java-Hebbal, J. 247 and Red Mauritius was almost universal in the Southern Districts like Chittoor, Coimbatore and South Kanara. Besides these, Poovan, Vellai and a few other canes were also grown in the beginning of this century in the Coimbatore and adjacent districts.

Among the early releases of Coimbatore seedlings, Co 213 was the most important and spread extensively to many parts of this and other Provinces. By its introduction, cane cultivation was extended to areas previously considered unsuitable. Cultivation practices and ideas associated with the "*Noble*" type of canes (B. 208, Purple Mauritius etc.) underwent a radical change. The irrigation expenses were considerably reduced. During this period, POJ.2878 from Java, Co 243, Co 313, Co 349, Co 281 and Co 290 from Coimbatore also attained a certain measure of importance. The latter two varieties exist even now on a fairly extensive scale in the South Arcot and Bellary Districts (3). The popularity of Co 213 began to wane after about a decade and Co 419, introduced in 1934–'35 completely eclipsed it. This variety has now supplanted all other varieties and is the premier cane of the Province at present. Older varieties had some 'predilection spots' to which they clung for a longer time than in other places. This was due to certain natural and artificial causes influencing cane cultivation. It may not be far wrong to state that factory influence is sustaining the acreage under Co 281, as well as small areas under Co 349 and POJ.2878 in the South Arcot District. But Purple Mauritius which was liked for its jaggery quality and lack of spines on the leaf sheaths was retained till 1944, in the Ramachandrapur taluk of the East Godavari District. In the Peddapuram area of the East Godavari District, J. 247 and Co 213 occupied large areas till 1942 but both were swept away by the spread of Co 419. Co 313 was occupying a fairly large area (1000 acres) in the Vizagapatam District, (Bobbili area) till 1941 but gave place to other promising early canes like Co 527 and Co 421. Similarly B. 208 which was very popular in the Anakapalle tract of this district for its good quality jaggery is now grown only in small areas for chewing purposes. In the Bellary District, the *Hotta Kabbu* and others were displaced by Co 290 which in turn is rapidly yielding ground in recent years to the universal cane for this Province, Co 419. Similarly Red Mauritius in the Salem and South Kanara Districts is reported to be fast giving place to Co 419 and is being used more for chewing than for *gur* making. Thus there was a change of varieties periodically due to some reason or other; whether due to deterioration of the older varieties of the superior growth and vigour of the new varieties. The question, whether the sugarcane varieties deteriorate and if so whether deterioration is due to physiological or genetic causes, is discussed in the subsequent pages.

3. **Asexual Propagation and Heterosis.** Utilisation of hybrdi vigour of *heterosis* is the key to the successful evolution of better types of plants in vegetatively reproduced crops like sugarcane. Heterosis is known to increase as the disparity of the parental stocks increases. Unrelated autogamous varieties show more heterosis when crossed. This phenomenon was sought to be exploited in sugarcane breeding work, during the course of which widely differing genera and species *(Sorghum and Bamboo, Sacharum Spontaneum S. Arundinaceum etc.,)* were utilised. Since cultivation of the hybrid cane seedlings is almost universal in this Province, a study of their characters and causes for their replacement after some time, also means a study of the heterosis exhibited by the seedlings.

*(i) Deterioration.* Deterioration of seedling cane varieties will also mean loss of heterosis, in a way, as explained above. Earle, writing on sugarcane in Puerto Rico said that the soil rather than the varieties deteriorated. (Quoted by Noel Deerr in Cane Sugar, 1927) (4). East observed that loss of hybrid vigour was due to disease (5). Pal and Nek-Alam (10) reported that the expression of heterosis was greatly influenced by various external factors (season etc.) They quoted Bredemann and Henser (2) and Bolsunov (1) in support of their contention. Ramaiah and Ramaswami (11) assert that hybrid vigour can be maintained indefinitely, unless disease affects the plant. Luckwill (9) reported (according to Ganesan—1942) that heterosis might make its appearance at any stage of the life cycle of the plant. Kadam (8) lists the most important causes of supposed and real deterioration as (a) developmental variation, (b) mechanical mixtures, (c) mutations, (d) natural crossing, (e) minor genetic variations, (f) selective influence of diseases and (g) the technique of the plant-breeder. He particularly stressed that in vegetatively propagated crops like potatoes and sugarcane unwitting distribution of inferior bud mutations during a period of many years may lead to the serious deterioration in the quality and productivity of well-known varieties. Kadam's conclusion that diseases, rather than climate, play important roles in worsening a variety is applicable to sugarcane. Well-known instances are of Co 213 in the United Provinces and Purple Mauritius in this Province. That incidence of pests will also lead to deterioration in quality and yield of sugarcane is too well-known to need emphasis here (7).

*(ii) Spotting of a genetically superior bio-type.* The remarkable progress achieved by the sugar industry in this country is due to two causes. The primary one is the protection afforded by the Government by building a tariff wall against imports of foreign sugar. The second is the rapid progress in the evolution of superior types of cane seedlings from time to time to suit different localities and climates. An examination of varietal experiments at the Sugarcane Research Station, Anakapalle, clearly brings out that a particular variety found to be yielding best in a particular

period maintained its position only till a better-yielding variety was introduced and then it naturally yielded place to the new variety. For instance, from 1926 onwards when Co 213 was introduced, the importance of J. 247 waned. Co 213 yielded better and withstood adverse growth conditions extremely well, when J. 247 practically failed. Co 213 dominated the cane area only for a decade (till 1936). By then Co 419 was already multiplied. It was such a high-yielding cane that none of the varieties that were already tried or under trial then could approach it from the point of yield. This gradually replaced almost all the varieties under cultivation in this Province.

(4) **Discussion.** Data pertaining to four important varieties from the Sugrcane Research Station, Anakapalle, are furnished in the appendix to afford a comparative idea of their performance from year to year under identical conditions of crop growth except for seasonal variations. The crop on the Research Station was kept free from disease and the manurial and other cultural treatments were identical every year. The seed material for each year was grown on the same field for all the varieties and was kept scrupulously free from disease. It is clear from these figures that there was no definite downward trend in the yield or other economic characters of any particular variety. They indicate also that there was no deterioration of the variety as such genetically but that the fluctuations in yield and other characters were the result of seasonal effects. Thus an incidence of pests and diseases as a result of indifferent cultivation were responsible for the deterioration of cane varieties and introduction of superior seedlings was responsible for the replacement of varieties already under cultivation.

5. **Summary and Conclusions.** The performance of the more important cane seedlings grown in the Madras Province is reviewed in a general way from the point of their spread and decline. The causes for their deterioration and replacement are also discussed. The most important factor responsible for a variety to 'run out' seems to be the incidence of disease. Instances of inferior bud mutations or loss of heterosis due to other genetic causes were not noted in the case of sugarcane. Evolution of superior types of cane varieties from time to time was responsible for the replacement of once-popular cane varieties by others after some time.

6. **Acknowledgments.** I am grateful to Sri. N. L. Dutt, Sugarcane Expert, Indian Sugarcane Breeding-Station, Coimbatore, for his helpful criticism and valuable suggestions in the preparation of this paper. My thanks are also due to the Superintendent, Sugarcane Research Station, Aankapalle, for facilities afforded in preparing this paper during my stay at Anakapalle.

**Literature cited.**

1. Bolsunov II (1936) — Studies on the heterosis or growth vigour in Nicotiana rustica plants. (Russian with English summary) USSR. Institute of Tobacco Investigations Bull., No. 132 pp. 118–128 (original not seen).
2. Bredemann, G. and Henser, W. (1931)—"Beitrage Zur Heterosis bei Roggen" Z. Zwchtung A", 16 pp. 1–56 (original not seen.)
3. Dutt, N. L. — Varietal composition of the Sugarcane crop in India in 1941 —'42.
4. Earle, F. S. (1927) — Quoted by Noel Deerr in Cane sugar.
5. East, E. M. (1936) — Heterosis, Genetics Vol. 21 pp. 375–397.
6. Forty Second Annual Report of the Bureau of Sugar Experiment Stations, Queensland (1941).
7. Haldane, J. H. (1938)–Quality of cane in North India in relation to Borer infestation.....Agric. and Live-Stock. Ind. Vol. I Part V (original not seen) Extract from Facts about Sugar Vol. 34 (1939).
8. Kadam, B. S. (1942)–Deterioration of varities of crops and the task of the Plant-Breeder ..... The Ind. Journal of Genetics and Plant-Breeding Vol. 2 No. 2 pp. 159–172.
9. Luckwill, L. C. (1939) — Observations on Heterosis in Lycopersicum, J. Genetics, 37 : 421 : 40 (original not seen).
10. Pal, B. P. and Nek-Alam (1938) — The effect of certain external factors upon the manifestation of hybrid vigour in wheat — Proc. Ind. Academy of Scie. Vol. 7 Sec B. pp. 109–124.
11. Ramaiah, K. and Ramaswami, K. (1941)— Hybrid vigour in Rice. The Ind. Journal of Genetics and Plant-Breeding Vol. I pp. 4–12.

**Briquettes from Bagasse.**— Tsuneo Tatsuno, pp. 104—109 (1947). Bagasse is carbonized either by dry distillation in a retort with recovery of methyl alcohol and acetic acid, or in a primitive bee-hive even as in the manufacture of wood charcoal; if expertly managed, the latter process is the cheapest. In either case the carbonized material is moulded with 20% of clay as a binder. The dried briquettes ignite very easily (at 208°C.), much easier than ordinary wood charcoal. The fuel value of the briquettes is 3960 KCAL. (Sugar Vol. 43, No. 7, July 1948, p. 49).

# Some Aspects of Ratooning in Sugarcane

*By*

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## 1. Introduction.

Ratooning Sugarcane is the growing of successive crops from one year's planting after every harvest and is practised in many of the sugarcane-growing countries of the world, as for example in Louisiana, Mauritius, Cuba, West Indies, British Guiana and in Hawaii islands. In India the practice was not common due mainly to lack of suitable varieties, but the position has now changed, with the introduction of hardy seedling canes from Coimbatore. It has now become a general practice in many places to ratoon canes. In places like Valavanur in South Arcot District of this Province even seventh and eighth ratoon crops are being taken with the variety Co 281.

## 2. Area under Ratoons.

No reliable figures are available with regard to the area under ratoons. In the Season and Crop Reports (2) the percentage of area under ratoons is said to vary from 5·83 to 12·48% of the total area under sugarcane. In order to assess to a fair degree of accuracy the extent of ratooning that is practised, the area under plant crop and ratoon in a few villages in Gudiyatham taluk were ascertained. The figures are given below :—

TABLE I.

| Serial No. | Year | Name of Village | Total area under cane in acres | Area under Ratoons in acres | Percentage area under Ratoons to total cane area |
|---|---|---|---|---|---|
| 1. | 1947 | Thalayatham | 94·90 | 45·22 | 47·64 |
| 2. | 1944 | Cheruvanki | 97·64 | 49·45 | 50·64 |
| 3. | 1944 | Melalathur | 31·69 | 9·03 | 28·49 |
| 4. | 1944 | Kil Vaithanankuppam | 104·95 | 50·18 | 47·78 |
| 5. | 1944 | Mailpatti | 73·35 | 44·72 | 60·96 |
| 6. | 1944 | Ithampet | 87·98 | 56·72 | 64·48 |
| 7. | 1944 | Kailasagiri | 70 25 | 41·59 | 59·20 |
| | | Total. | 560 76 | 296 91 | 52·94 |

Thus the area under ratoons varied from 28·49 to 64·48% with an average of 52·94% of the total area under sugarcane. Dutt (7) has pointed that the percentage of area under ratoons has shown a considerable increase during the last few years, and the figure is now more than 30% of the total area under sugarcane

**3. The Present Position of Ratooning.**

The reasons for the increasing popularity of ratooning is the saving in the cost of cultivation as the expenses towards preparatory cultivation and planting are avoided and also the ease with which a fairly good crop can be grown without taking the trouble of planting again. Yet opinions with regard to the economics of ratooning vary, and are sometimes even conflicting. Some experiments have already been done on this aspect in some Research Stations like Anakapalle, Palur, Samalkot and Gudiyatham in this Province and in Mushari in Bihar and Kalai in the United Provinces. In an earlier experiment done at Anakapalle (1934—'35) it was stated that the general growth of cane, density of crop, ripening, and tonnage are better in the ratoon crop than in the plant (3) while in a subsequent trial with a standard method of layout with the variety Co 419, ratoons were found to yield less than plant crops and it was found economical to take only one ratoon crop (6). At Palur (1935—'36) ratoons were shorter and less in yield than plant crop and were also more susceptible to insect pests and diseases (5). At Samalkot thin canes were found to be better ratooners than thick canes (4). In Mushari. Bihar, no reliable conclusions could be drawn with regard to the growth and yield of cane owing to the abnormally poor crop (7). At Muzaffarnagar some indications were obtained that for ratooning the best time for harvest is late February or March. At Kalai it was possible to get as high yields from the ratoon crop as from the plant cane and the cost of cultivation of a ratoon crop was also much less than that of a plant crop. At Gudiyatham with increasing doses of manure the first two ratoons of varieties like Co 213 gave higher yields than plant crops.

**4. Ratoon Experiment at the Sugarcane Research Station, Gudiyatham (1936—1939)**

Three varieties Co 213, Co 414 and J. 247 were ratooned successively for three years and compared with a plant crop every year. The layout was 2 x 3 x 6 randomised blocks (split-plot design) with ratoon and plant crops as the main plot, and varieties as sub-plots, with six replications. The area of each sub-plot was 2 cents. The manurial doses were as given below:

| | | |
|---|---|---|
| Plant crops | ... | 150 lb. Nitrogen (100 lb Ammonium Sulphate and 50 lb. as groundnut cake.) |
| 1st Ratoon | ... | 200 lb. Nitrogen (100 lb. as Ammonium Sulphate and 100 lb. as groundnut cake) |
| 2nd Ratoon | ... | 250 lb. Nitrogen (150 lb. as Ammonium Sulphate and 150 lb. as groundnut cake) |
| 3rd Ratoon | ... | 300 lb. Nitrogen (150 lbs. as Ammonium Sulphate and 150 lb. as groundnut cake) |

All these were over a basal dressing of 10 tons farmyard manure and 2 cwts. superphosphate per acre.

*Results*: (i) *Yield*. The yields of cane from plant crops and ratoons of the different varieties are given below:—

**TABLE II**

**Yield of cane in tons per acre.**

| | *Ratoon crop.* | | | *Plant crop.* | | |
|---|---|---|---|---|---|---|
| | Co 213 | Co 414 | J. 247 | Co 213 | Co 414 | J. 247 |
| I. Ratoon | 62·32 | 52·54 | 11·70 | 52·05 | 45·98 | 40·92 |
| II. ,, | 54·87 | 42·56 | 12·44 | 46·99 | 41·02 | 43·45 |
| III. ,, | 49·75 | 41·74 | 6·43 | 47·12 | 42·57 | 36·47 |

In Co 213, the first and second ratoon yields were significantly higher than their plant crops by 19·8% and 16·8%, but the yield in the third ratoon though 5·5% more than the plant crop, was not significant. Co 414 first ratoon was significantly more in yield than its plant crop by 14·2%, while the second and third ratoons were more or less similar. J. 247 first and second ratoons were very poor crops with only 28·6% of the yield of plant crops while its third ratoon recorded the lowest yield, being only 17·6% of the plant crop.

Co 213. a medium cane proved the best ratooning variety. Co 414, though a thick cane was also found to ratoon well, though not as good as Co 213. J. 247 was a total failure as a ratoon. It has to be noted that there was a gradual decline in yield in the case of subsequent ratoons, but yet even the third ratoon crops of Co 213 and Co 414. with increasing dose of manure were as good in yield as their plant crops.

(ii) *Number of canes per acre.* It can be readily conceded that the yield of cane from a plot or acre will depend upon the number of canes per acre and the individual development or weight of cane. The number of canes per acre, taking other conditions as normal, will depend on the germination and tillering or ratooning capacity of the variety. When the cane stool is harvested or ratooned, the tendency is for each of the underground portion of the secondary shoots as well as the main shoot to produce new shoots in turn. It is therefore reasonable to expect a larger number of shoots in a ratoon crop. This is borne out by the figures given below :—

**TABLE III**

**Showing the number of canes harvested per acre**

| | *Ratoon crop* | | | *Plant crop.* | | |
|---|---|---|---|---|---|---|
| | Co 213 | Co 414 | J. 247 | Co 213 | Co 414 | J. 247 |
| 1st Ratoon | 76,025 | 42,392 | 11,908 | 59,058 | 35,033 | 40,133 |
| 2nd ,, | 68,967 | 32,700 | 10,300 | 56,892 | 31,542 | 37,600 |
| 3rd ,, | 61,917 | 28,967 | 6,400 | 61,517 | 32,250 | 85,633 |

The number of canes per acre in the case of first ratoons of Co 213 and Co 414 were 28·7% and 21% respectively more than their plant crops. The number of canes in the second ratoon of Co 213 was also more by 21·3% while that of Co 414 was only 3·6% more than its plant crop. There was however a gradual decline in the number of canes per acre, with

successive ratooning, probably owing to the tendency for the older parts to die away. The period of profitable ratooning of any variety will therefore depend on this feature. Here again the unsuitability of J. 247 for ratooning was brought about by the miserably poor stand of the first, second and third ratoons which were only 29·7%, 27·4% and 18% respectively in number of the plant crops.

At Anakapalle the number of canes per acre of the first ratoons of certain varieties were said to be more than their plant crops (6). The results at Gudiyatham are in conformity with these results.

(iii) *Developmeut of canes.* It is a resultant of the length and thickness of cane, which in turn depends on the variety, soil, climate and conditions of growth.

(a) *Growth.* At Anakapalle (6) it was stated that ratoons receiving the same dose of 100 lb. Nitrogen as the plant crop were always shorter than plant crops. At Gudiyatham ratoons which received higher doses of manure than plant crops, (varying from 200 to 300 lb. Nitrogen), were not shorter than plant crops, but were even taller, except in the case of a poor ratooner like J. 247. Ratoons also made very vigorous growth in the initial stages.

(b) *Thickness of cane.* The average thickness of cane depends on the total number of canes per acre, and also on the manurial treatment. In the case of Co 213. 1st ratoon canes were definitely thinner, due presumably to an increase in the number of canes per acre, while in J. 247, ratoons were always thicker, owing to fewer number of canes.

(c) *Weight of Millable Cane.* This is the measure of the individual development of cane. In order to determine the difference in the development of plant crops and ratoons, the weights of millable cane were recorded for each sub-plot and the differences compared. The results are given below :—

**TABLE IV**

| | Weight of Millable cane in lb. | S. E. of difference | |
|---|---|---|---|
| Co 213 Plant | 1·995 | | |
| ,, 1st Ratoon | 1·838 | 0·055 | Significant. |
| Co 213 Plant | 1·848 | | |
| ,, 2nd Ratoon | 1·784 | 0·077 | Not significant. |
| Co 213 Plant | 1·719 | | |
| ,, 3rd Ratoon | 1·795 | 0·035 | do. |
| Co 414 Plant | 2·954 | | |
| ,, 1st Ratoon | 2·779 | 0·118 | do. |
| Co 414 Plant | 2·900 | | |
| ,, 2nd Ratoon | 2·818 | 0·157 | do. |
| Co 414 Plant | 2·959 | | |
| ,, 3rd Ratoon | 3·221 | 0·067 | Significant. |
| J. 247 Plant | 2·344 | | |
| ,, 1st Ratoon | 2·121 | 0·147 | Not significant. |
| J. 247 Plant | 2·578 | | |
| ,, 2nd Ratoon | 2·702 | 0·128 | do. |
| J. 247 Plant | 2·286 | | |
| ,, 3rd Ratoon | 2·205 | 0·048 | do. |

It can be seen that though the 1st ratoon of Co 213 was taller than the plant crop, the individual weight of the ratoon cane was significantly less than the plant crop, owing to the increase in the number of canes and consequent thinness. The differences in weight between plant crops and 2nd and 3rd ratoons were not significant. Similarly in the weight of millable cane of Co 414 first and second ratoons, the differences were not significant, while the 3rd ratoon was definitely weightier and better in development than plant crop. Differences in weight between plant crops and ratoons were not significant in the case of J. 247. Thus it is seen that under favourable conditions, ratoons are capable of making even better development than plant crops.

As mentioned before, the yield of cane is a function of the number of canes per acre, and the weight of millable cane and this fact is brought out by the tabular statement below :—

TABLE V

| Treatments | Number canes % increase or decrease over plant crop | Weight of millable cane % increase or decrease over plant crop. | Yield of cane % increase or decrease over plant crop. |
|---|---|---|---|
| Co 213, 1st Ratoon | 28·7 | —7·9 | 19 8 |
| ,, 2nd ,, | 21·3 | —3·4 | 16·8 |
| ,, 3rd ,, | 0·7 | +4·9 | 5·5 |
| Co 414, 1st ,, | 21·0 | —5·9 | 14·2 |
| ,, 2nd ,, | 3·6 | —2·9 | 3·8 |
| ,, 3rd ,, | —10·0 | +8·8 | — 1 9 |
| J. 247, 1st ,, | —70 3 | —9·5 | —71·4 |
| ,, 2nd ,, | —72·6 | +4·8 | —71·4 |
| ,, 3rd ,, | —82·0 | —3·5 | —82·4 |

The increase or decrease in yield of ratoons over plant crop is more influenced by the number of canes, which is dependent on the ratooning capacity of the variety. Hence the success of ratooning depends upon the selection of a suitable variety that has good ratooning capacity, and giving it adequate manure for proper development.

TABLE VI

**Frequency table of root system**

| | Co 213 Plant crop. | | | Co 213, 3rd Ratoon | | | Co 414 Plant crop. | | | Co 414, 3rd Ratoon. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class in inches | Number of vertical roots. | Number of lateral roots. | Total. | Number of vertical roots. | Lateral roots. | Total. | Vertical roots. | Lateral roots. | Total | Vertical roots. | Lateral roots. | Total. |
| 3" | 70 | ... | 70 | 55 | .. | 55 | 26 | ... | 26 | 61 | ... | 61 |
| 9" | 38 | 1 | 39 | 37 | . | 37 | 14 | .. | 14 | 25 | ... | 25 |
| 15" | 12 | .. | 12 | 27 | 1 | 28 | 10 | | 10 | 48 | 2 | 50 |

| | Co 213 Plant crop. | | | Co 213, 3rd Ratoon. | | | Co 414 Plant crop. | | | Co 414, 3rd Ratoon. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class in inches. | Number of vertical roots. | Number of lateral roots. | Total. | Number of vertical roots. | Lateral roots. | Total. | Vertical roots | Lateral roots. | Total. | Vertical roots. | Lateral roots. | Total. |
| 21" | 10 | 1 | 11 | 16 | ... | 16 | 6 | 1 | 7 | 28 | ... | 28 |
| 27" | 6 | | 6 | 9 | ... | 9 | 3 | 3 | 6 | 12 | 2 | 14 |
| 33" | ... | 1 | 1 | 4 | 3 | 7 | 1 | 2 | 3 | 4 | 2 | 6 |
| 39" | 3 | 1 | 4 | 3 | 1 | 4 | ... | 1 | 1 | 6 | 1 | 7 |
| 45" | 1 | 1 | 2 | 1 | ... | 1 | 3 | 3 | 6 | 2 | 2 | 4 |
| 51" | 2 | 1 | 3 | 2 | 2 | 4 | 1 | 2 | 3 | 1 | . | 1 |
| 57" | ... | 1 | 1 | 1 | 3 | 4 | 3 | 1 | 4 | 3 | 1 | 4 |
| 63" | ... | ... | ... | 1 | 1 | 2 | 1 | ... | 1 | 1 | 1 | 2 |
| 69" | ... | ... | ... | ... | 1 | 1 | ... | 1 | 1 | ... | ... | ... |
| 75" | ... | ... | ... | ... | ... | ... | ... | 1 | 1 | 1 | ... | 1 |
| 81" | ... | ... | ... | ... | ... | ... | ... | 1 | 1 | ... | .. | ... |
| 87" | ... | ... | ... | ... | ... | ... | ... | 1 | 1 | ... | ... | ... |
| 93" | ... | ... | ... | . | ... | . | ... | 1 | 1 | ... | ... | |
| Total Nos. | 142 | 7 | 149 | 156 | 12 | 168 | 68 | 18 | 86 | 192 | 11 | 203 |
| Total lentgth of roots | | | 1368" | | | 2067" | | | 1014" | | | 2856" |
| Weight in ounces | | | 3⅛ | | | 2¼ | | | 3¼ | | | 2½ |
| Height of cane in inches | | | 119 | | | 122 | | | 127 | | | 137 |

(iv) *Root system.* Roots have a direct bearing on the growth of any plant as they are not only the anchors, but are also the feeders. The root-systems of plant crops and ratoons were studied in the plant crops and 3rd ratoons of the varieties Co 213 and Co 414. The root-systems were exposed intact by carefully removing the soil around the roots. Both the lateral and vertical roots were traced and their number, length and the depths to which they extended were noted. An exact diagram to scale of the root systems was also drawn, which is appended. The data presented in Table VI will bring out clearly the better root-system of ratoons as compared with the plant crop. The number, length, and depth, to which the roots penetrated were greater in ratoon than in the plant crop. Nearly two-thirds of the total number of roots were confined to the first 15 inches and the roots extended to a depth and length of 7¾ feet. Root development was best in Co 414, 3rd ratoon, in which the growth and development of cane was also the maximum. As the ratoons have a better root-system, it is only natural to expect them to make quicker and even better growth, provided they are adequately manured.

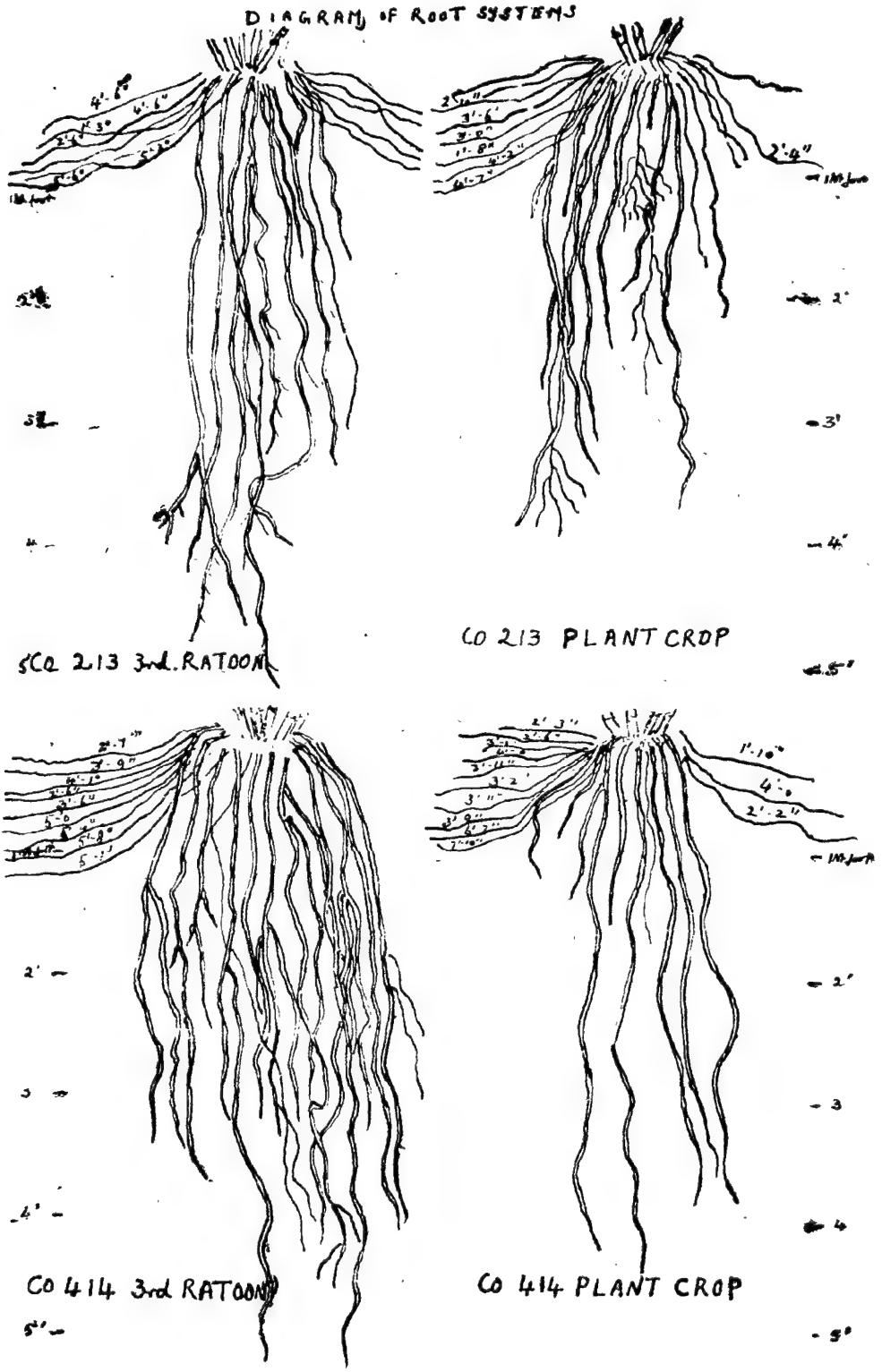
DIAGRAM OF ROOT SYSTEMS
CO 213 3rd. RATOON
CO 213 PLANT CROP
CO 414 3rd RATOON
CO 414 PLANT CROP

TABLE VII.

**Juice quality and jaggery recovery in plant and ratoon crops**

| Treatments | % Sucrose during | | | | | % Purity during | | | | | % Jaggery to Cane | Yield of Jaggery in tons per acre |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct. | Nov. | Dec. | Jan. | Feb. | Oct. | Nov. | Dec. | Jan. | Feb. | | |
| Co 213, Plant | ... | 8·20 | 11·00 | 11·79 | 14·49 | .. | 65·24 | 74·52 | 76·78 | 84·26 | 11·53 | 6·00 |
| Co 213, 1st Ratoon | ... | 8·21 | 10·12 | 11·42 | 13·24 | ... | 66·48 | 74·08 | 76·33 | 82·24 | 10·79 | 6·72 |
| Co 213, Plant | 7·68 | 11·11 | 12·40 | 11·13 | 16·65 | 64 97 | 75·06 | 78·47 | 86·34 | 87·14 | 12·27 | 5·77 |
| Co 213, 2nd Ratoon | 8·36 | 9·57 | 13·08 | 14·85 | 15·50 | 67·85 | 71·42 | 81·23 | 84·94 | 85·59 | 11·43 | 6·27 |
| Co 213, Plant | 9·14 | 11·26 | 12·79 | 15·50 | 15·68 | 70·50 | 77·59 | 81·79 | 86·18 | 87·28 | 11·09 | 5·23 |
| Co 213, 3rd Ratoon | 8·91 | 10·15 | 11·54 | 14·97 | 13·55 | 71·36 | 76·25 | 77·23 | 87·02 | 84·82 | 11·81 | 5·87 |
| Co 414, Plant | ... | 11·04 | 14·41 | 14·77 | 15 77 | ... | 74·78 | 82·08 | 82·69 | 84·70 | 12·46 | 5·73 |
| Co 414, 1st Ratoon | ... | 12·52 | 14·09 | 15·07 | 14·85 | ... | 76·52 | 81·96 | 83·58 | 83·96 | 11·80 | 6·20 |
| Co 414, Plant | 11·61 | 14·29 | 16·43 | 18·80 | 17·65 | 75·51 | 81·66 | 84·18 | 87·54 | 86·48 | 12·93 | 5·28 |
| Co 414, 2nd Ratoon | 12·20 | 15·19 | 16·46 | 17·15 | 16·91 | 75·70 | 83·35 | 85·78 | 87·44 | 86·24 | 12·40 | 5·31 |
| Co 414, Plant | 13·51 | 13·15 | 15·35 | 17·95 | 17·97 | 81·41 | 79·16 | 84·07 | 88·35 | 86·98 | 11·89 | 5·05 |
| Co 414, 3rd Ratoon | 12·59 | 13·35 | 14·89 | 15·88 | 16·37 | 80·13 | 82·58 | 84·43 | 85·29 | 85·25 | 11·63 | 4·85 |
| J. 247, Plant | ... | 7·04 | 9·17 | 11·46 | 12·47 | ... | 60·85 | 69·16 | 77·27 | 80·97 | 10·05 | 4·11 |
| J. 247, 1st Ratoon | ... | 9·04 | 9·09 | 12·30 | 13·84 | ... | 67·85 | 68·93 | 80·24 | 83·89 | 11·32 | 1·32 |
| J. 247, Plant | 5·28 | 7·38 | 9·72 | 13·41 | 15·75 | 53·22 | 63·19 | 70·96 | 82·83 | 86·50 | 11·85 | 6·15 |
| J. 247, 2nd Ratoon | 6·97 | 7·86 | 12·43 | 15·19 | 16·38 | 60·49 | 65·07 | 79·27 | 85·37 | 87·08 | 11·70 | 1·46 |
| J 247, Plant | 7·33 | 8·53 | 11·73 | 14·92 | 15·63 | 63·80 | 67·69 | 77·49 | 85·23 | 86·54 | 12·61 | 4·59 |
| J. 247, 3rd Ratoon | 9·36 | 9·82 | 11·32 | 15·27 | 12·54 | 70·86 | 72·59 | 75·93 | 87·22 | 75·23 | 11·33 | 0·73 |

Ratoons of Co 213 and Co 414 showed a lower purity and jaggery recovery than their plant crops owing to the higher dose of Nitrogen which the ratoons received. But deterioration started by February *i. e.*, a month earlier in the ratoons than in the plant crop thereby showing that ratoons mature earlier than their plant crops. However, the total jaggery yield based on cane weight and recovery was about 12% more in the case of Co 213 ratoons. Co 414 first ratoon was 8% more in yield than the plant crop.

(vi) *Pests and diseases.* There is a general belief that ratoons are more susceptible to insect pests and diseases than plant crops, but the results obtained at some of the research stations are rather varied. Among the pests of sugarcane, borers, *e.g.*, early side-shoot borer (Argyria sticti craspie H), top borer (Scirpophaga Nivella F.) and the internode borer (Diatroea Venosata W), mealy bugs, Pyrilea and termites are the most important in this Province. Early side-shoot borers which attack the crop in the early stages, are not considered serious, as the crops revive by better tillering or production of new shoots in the place of attacked ones. Top borers bring about the death of cane out-right as they burrow into the apical growing shoot and are therefore a serious pest. Internode borers, though they do not kill the cane, cause appreciable reduction in juice quality. Pyrilla or the leaf hopper is not such a serious pest in South India as in the North. At Palur, 52% of ratoons were said to be attacked by borers while the damage to the plant crop was only 10%. Cane-fly and mealy bugs were more in ratoon plants (5). At Anakapalle the Pyrilla attack was said to be more severe in ratoons in 1934—'35 (3) though their incidence was said to be more in plant crops in 1941—'42. Mealy-bug attack was more severe in ratoons, while in the case of borers, except during 1943—'44 plant crops showed a decidedly higher percentage of borer attack (6). At Gudiyatham the incidence of borer attack was generally more (10 to 33%) in ratoon (Table IX). Mealy-bug attack was also more in ratoons. The percentage of borer attack in the third ratoon was also higher than in the first and second ratoons. Among the fungus diseases, Smut (Ustilage Scitaminea Syd) was found to be the most serious of the diseases. Smut which can be easily recognised by the terminal portion of cane turning into a whip-like structure was found to be definitely on the increase in the ratoon crops and the third ratoon of Co 213 had a very severe infection. The reduction in the number of canes in subsequent ratoons can also be partly due to the removal and burning of all the affected clumps. Of the three varieties (*viz.*) Co 213, Co 414 and J. 247 under trial, Co 213 was the worst infected with Smut while both the plant and ratoon crops of Co 414 were free. It is remarkable that the variety Co 414 although by the side of a heavily smut-infected crop of Co 213 was absolutely free from smut. The causes for the greater susceptibility ratoons of certain varieties and the comparative freedom of other varieties deserve special investigation and it is possible that the smut problem in ratoons could be solved by the selection of suitable resistant varieties.

However, in localities where the smut has assumed serious proportions, ratooning should be stopped and the disease should be controlled by roguing and burning of affected clumps, planting of healthy setts from a locality where there is no infection.

TABLE VIII

**Showing the percentage of top-borer attack**

| | Ratoons | | | Plant Crop | | |
|---|---|---|---|---|---|---|
| | Co 213 | Co 414 | J. 247 | Co 213 | Co 414 | J. 247 |
| 1st Ratoon ... | 18·6 | 24·5 | 19·4 | 20·0 | 19·8 | 16·2 |
| 2nd Ratoon ... | 27·9 | 25·4 | 16·3 | 19·1 | 23·5 | 16·5 |
| 3rd Ratoon ... | 31·9 | 37·8 | 25·4 | 19·1 | 26·5 | 18·5 |

(vii) *Cost of Production of Cane.* The cost of cultivation of cane for the plant crop and ratoons along with the cost of production per ton of cane are given below :—

| Variety | Plant crop | 1st Ratoon | 2nd Ratoon | 3rd Ratoon |
|---|---|---|---|---|
| | Rs. A. P. | Rs. A. P. | Rs. A. P. | Rs. A P. |
| | *Cost of cultivation and harvest per acre.* | | | |
| All varieties | +286 6 0 | 238 3 4 | * 290 0 8 | 243 10 2 ... |
| | *Cost of production per ton of cane.* | | | |
| Co 213 | 5 15 7 | 4 3 3 | 5 4 7 | 5 3 0 ... |
| Co 414 | 6 10 3 | 4 12 3 | 6 13 0 | 6 0 1 ... |
| J. 247 | 7 0 7 | 17 4 8 | 23 5 0 | 36 8 8 |

*N. B.*— (a) Cost of cultivation above refers to pre-war rates during 1937—'38 to 1939—'40.

(b) Cost of cultivation excludes rental value of land.

(c) The figures for the plant crop is the average of the cost of production for three years.

(d) * Cost of cultivation of 2nd ratoon is high owing to greater expenses involved in lifting and tying up lodged canes.

Cost of cultivation as shown above is naturally reduced in the case of ratoons to an extent of about 15 to 17% as there is a saving in expenses towards preparatory cultivation and planting. Except in the case of J. 247, where the yield of ratoons was very poor, the cost of production per ton of cane was less in ratoons. The cost of production was less in first ratoons by about 30% as increased yields, were obtained with less of cultivation costs. It was economical to take even a third ratoon of Co 213 and Co 414 though the margin of difference between plant crop and subsequent ratoons got narrower.

5. **Future Lines of Work.** (i) It is clear that varieties differ greatly in their ratooning capacity, hence a search for better varieties, which possess good ratooning capacity has to be pursued in Research Stations and their profitable period of ratooning worked out.

(ii) The reported low yields of ratoons with similar dose of manure as plant crop at Palur and Anakapalle, and the higher yields of the first two ratoons with increased doses of manure at Gudiyatham, show that ratoons need heavier manuring and the optimum dose of manure required for ratoons has to be worked out.

(iii) The greater susceptibility of ratoons to insect pests and fungus diseases require investigation with special attention on the ultimate economics and effective control measures.

Smut appears to be the most important fungus disease affecting ratoons and as certain varieties are found to be resistant to smut, selection of resistant varieties which are desirable from other economic factors also would be a desirable line of investigation.

(iv) The best time to harvest the parent crop to be ratooned, so that the ratoon may get the best conditions for growth, deserves a special study.

(v) Harvesting the crop to be ratooned flush to the ground level or as low as possible is said to give vigorous sprouts. This aspect also needs investigation.

(vi) As ratoons mature earlier than a plant crop, if suitable early varieties themselves can be ratooned, the sugar factories can well start their work nearly a month in advance; work in this direction deserves attention.

(vii) The practice of burning cane trash *in situ* after harvest is rather a general practice with ryots and this is done mainly with the idea of saving the cost of labour involved in clearing the trash. This practice is believed to be harmful as it leads to loss of humus in the top soil and it may be advantageous not to burn the trash, but to compost them and return to the soil. The scientific and economic aspects of this have to be worked out to bring out the points of advantage and disadvantage more clearly.

(viii) The residual effects of ratoons on soil fertility need also investigation and a proper rotation has also to be worked out.

6. **Summary and Conclusions.** A brief review of the work done on ratoons is made and the experiment on ratoons at the Sugarcane Research Station, Gudiyatham, has been discussed in detail.

It was noted that varieties differ greatly in ratooning capacity and with increased dose of manure, the first two ratoons gave higher yields, than plant crops. It was economical to take third ratoon crops also, as the yields were similar to the plant crop, with a saving in the cost of cultivation.

As ratoons mature earlier than plant crops, they can take the place of early varieties in factory areas.

Ratoons were found to be more susceptible to insect pests and also to smut.

Future lines of work on various problems affecting ratoons are indicated.

**7. Acknowledgment.** The work done at Gudiyatham and reviewed here was subsidised by the Indian Council of Agricultural Research and the author acknowledges his grateful thanks to them. Acknowledgments are also due to the kind permission given by Sri R. Vasudeva Rao, Sugarcane Specialist, Anakapalle for making use of the data and for his helpful criticism.

**Literature Cited.**

1. Cane sugar (1911)—Noel Deer.
2. Season and crop report (1941—'42 to 1943—'44).
3. Annual Reports of Agricultural Research Station, Anakapalle, 1934—'35 and 1940—'43.
4. Annual Report of Agricultural Research Station, Samalkotta, 1935—'36.
5. Annual Report of Agricultural Research Station, Palur, 1935—'36.
6. Vasudeva Rao, R. and Lakshmikantham, M. (1946) Ratooning Sugarcane in Madras. Madras Agricultural Journal, Vol. No. XXXIV, Nos. 1, 2 and 3.
7. Dutt. N. L. (1946) Report on the Survey of Sugarcane Research in India.

# Agrarian Reforms

*(Evidence tendered to the Agrarian Reforms Committee)*

*By*

K. C. RAMAKRISHNAN

## Tenancy Problem.

There are various systems of land tenure in the Province – Zamindari, Inamdari, Ryotwari, Jenmi, Mulgeni, etc. — the first two of which are disappearing.

Except in Malabar and S. Canara where the Kanamdar and the Mulgeni tenants are a sort of under-ryots, standing between the ryots and the actual cultivators, we have no statutorily recognized under-ryots in the Province. In big estates of individuals or of institutions like Devasthanams, there are big lease-holders sub-leasing the land to smaller tenant-cultivators. But generally ryots deal with cultivators directly.

Rents in the case of cereal crops, paddy on wet lands and millets on dry lands, are partly determined by custom and partly by the fertility of land and water supply. Share rents, and also fixed leases in kind, vary from one-third to two-third of the gross produce and are based largely on the above considerations and partly on the contribution made by the landowners towards cost of cultivation. Share system, which is more common in the southern districts, is generally confined to poorer tenants, and depressed classes, while fixed leases are taken up by more solvent tenants. Commercial crops like sugarcane, plantain, cotton, tobacco and groundnut are leased out for fixed amounts of cash to quite solvent tenants, who can take care of themselves. They look more to rise in prices than to increase of yields for their profits. Rents of these crops are determined more by forces of supply and demand and prices ruling than by custom or by the will of the landlord.

Enhancement of rent is attempted at the time of renewal, if prices have risen at the time or have a prospect of rise. This is the reason why the term of tenancy is often as short as one year. Tenants are not keen in increasing the yield, lest it should lead to rise in rents.

Remission in rent is seldom given by any landlord completely. Abatement is common when the rains fail badly and there is no source of irrigation. It is generally followed by all renters in the whole village and is seldom an individual act. It is a common practice in such circumstances for fixed leases to be converted into *waram* or share-leases with abatements according to losses by weather or pests. Still it amounts to a serious loss to the cultivator who may not be able to recover the costs of his cultivation – even though it is a mercy that the landowner does not insist on his pound of flesh.

Compensation for improvements effected by tenants is a problem arising in long-term tenancy, as in Malabar, and seldom affects the short-term tenants unless it be for residual value of certain manures applied.

The incidence of rents is best studied in relation to net income and not as a share of the gross produce as cost of cultivation varies not only with the nature of the soil and water supply but with the nature of the crop. One uniform rate would be unfair, if related to gross produce and not net-income. This is recognised in the Ryotwari revenue settlement in the case of standard crops.

A land tribunal representing different interests is a good idea, but it may not function in a democratic manner in villages, where one or a few big landlords are dominant and cannot be challenged by those who depend on their favour. The tribunal should be allowed only a limited latitude in fixing up fair rent, which should have some relation to net income and not gross produce. The estimate of not only the latter but of the costs of cultivation must be made by an impartial agency.

## Economic Holding.

This is interpreted in various ways. Foreign writers mean by it an extent of holding which offers the maximum return on the capital and labour ready to be invested on land by a cultivator, be he an owner or tenant. In India it is not so much capital but labour available in the family of the cultivator that is taken into account by economists. Many of our writers, however, mean by an economic holding that which would offer enough for the subsistence of the family, whether it offers full employment or not. But whatever the interpretation, the extent of holding would vary with the nature of the crop and the intensity of its cultivation. Extreme examples at two ends would be millets and betelvine. Paddy, cotton, plantain, sugarcane, tobacco, chillies, vegetables, etc., come in between.

Village self-sufficiency is out of the question. Regional self-sufficiency may be attained except in case of crops requiring special kinds of soil, climate, water, skill and markets. All crops cannot be grown with equal ease in every region. But the orgy of transport, especially in bulky vegetables, fodder, etc., must be stopped.

An economic holding must provide, in any case, enough to maintain the cultivator and his family at a standard of living which satisfies the nutritional needs, including protective foods, which would sustain them on health and strength and promote efficiency—though any form of luxury might not be provided for. But it is difficult to draw a sharp line between where necessity ends and luxury begins in the case of clothing, if not also of housing. It may not be easy to get the needed income from the

cultivation of the holding alone, as in most cases there is a long off-season when nothing can be done on the land. A part of the income would have to be derived from the pursuit of some occupation allied to agriculture—such as dairying, poultry-farming, bee-keeping or some other industry such as hand-spinning.

Holdings, especially on wet land or irrigated area, are badly fragmented. Consolidation of holdings would mean a great convenience to the holders of the land, though its claims are often exaggerated. Consolidation is comparatively easier to effect if land is homogenous, but enlargement up to the economic size is very difficult. But supposing this were done by carving out bits of land from big holders and adding them to sub-economic holdings, would it be possible to retain the economic-holdings intact from generation to generation in the face of the operation of the law of equal inheritence among all sons? Even the reclamation of land on a large scale, for which chances are remote, or the industrialisation of the country, which would take time, cannot absorb the existing surplus labour on land. Intensity of cultivation by irrigation and otherwise may absorb a few. Meanwhile population grows.

More men might be employed, to be sure, if women labour were banned or discouraged on land—as has been the tendency in prosperous countries. But as it is, for the cultivation of a number of crops more women labour is employed than men labour on the whole, particularly in operations like weeding, transplanting and picking—operations in which the machine has made the least inroads in India.

Maximum limit to the size of holding may be prescribed in the case of mere rentiers but not such as to discourage experiments in large-scale farming by owners themselves, as has been carried on in Coimbatore District in recent years, though control over payment of wages and working conditions may be exercised by the State. It is better to encourage the purchase of additional land to round off uneconomic holdings—by means of easy loans, subsidy, advice, etc.

## Co-operative Farmimg.

This term is variously interpreted; but it is best to confine the use, of the term to joint farming carried on as a co-operative concern by agriculturists, who divide the produce according to the members' contributions in the shape of land, capital and labour—the value of which is assessed at market rates. Rights of private property are recognised and ownership is paid a dividend. Labour is paid for according to the quantity and quality of work done — not according to needs but according to services rendered. This distinguishes it from Collective Farming, which is ruled out under conditions in India.

But even Co-operative Farming is far from easy to carry on. In fact, of all forms of co-operative activity, it has been found to be the most difficult. A number of experiments have been made in different parts of the world, but nowhere has it been a conspicuous success except among Jews in Palestine, who have made a success of it in the face of difficulties, inspired by an extraordinary passion to settle down in the country and backed up the Jewish National Agency supported by the prosperous Jews of the world. Indian ryots are poles asunder from the Jews in Palestine in respect of education, industry. self-sacrifice, communal harmony, etc. The report of the Indian Delegation to Palestine makes it clear that none of the factors of success in that country is present in India and warns that Co-operative Farming in areas already cultivated would not be a feasible proposition — because of the land-laws and systems of land tenure and the individulistic attitude of the Indian farmer. The Delegation suggested the feasilibility of settling landless labourers on state or other cultivsble land to be reclaimed and run on the lines of the Small Holders' Co-operative Settlements in Palestine.

There is a longing not only for individual possession but individual cultivation of land, not only in this country but in all countries. This is the raison d'etre of colonisation schemes and small holders settlements in Europe—to settle landless labourers as independent tenants and would-be peasant-proprietors allowing them to pay the cost of land and of equipment in several instalments.

The whole co-operative structure in countries most advanced in co-operation is built on the foundation of peasant-proprietorship and individual cultivation as well as possession ; only it is supplemented by group effort in purchase, processing, sale, etc. This strong inclination for individual cultivation is observed in the so-called joint farming societies of Madras and Bombay. Co-operation is confined to the getting of credit and of leasing of land in common, which is sub-divided and let to tenant members for cultivation individually. Even in the newer colonisation societies where land is granted to landless labourers and ex-servicemen, though joint cultivation has been held up as an ideal, few are willing to take it up in practice. Even the little bit of common land allotted for the public park is neglected in colonisation societies of ex-servicemen in the Coimbatore district.

Thus the case for Co-operative Farming has not been established. Can it be argued that because our holdings are small and fragmented, the remedy is Co-operative Farming, carried on on a large-scale ? What are the economics of such large scale farming, not conducted by one dominant person, but with the consent of so many small folk ? By all means, consolidation and even enlargement of holdings up to an optimum size may be attempted. It can be done more effectively by compulsion which is

the method adopted by other countries rather than by co-operation, which is far too slow a method as has been proved in the Punjab and elsewhere in India. But the reconstituted holdings are better entrusted to old owner-cultivators or let on lease to competent tenants on fair rents and with fixity of tenure.

The utmost extent to which land reform could go in the conditions of this country is perhaps what is propounded by Mr. Tarlok Singh in his *Poverty and Social Change* — pooling all the small and fragmented holdings in the village, reconstituting them into compact holdings of different sizes to suit different families of cultivators, be they old owners or tenants; all these to pay fair rents to the joint village exchequer as fixed by the joint village management, on which all owners and cultivators are represented and which plans cropping schemes etc.

## Co-operation and Compulsion.

As already stated, consolidation of holdings, badly fragmented, is effected better by some sound measure of compulsion than by co-operation where the consent of every one concerned is required. That is the method usually adopted outside India. Only the consent of a majority of landholders holding the greater proportion of the land in the village is required; if that is obtained, the cantankerous minority is obliged to fall in.

A similar consent of a majority is required in the constitution and working of Marketing Boards in Britain and some of the Dominions, by which the produce of even the dissentient minority will have to be sold through the Marketing Boards, representing the interests of growers, traders and consumers. It is not left to any individual to sell his produce as he pleases.

Co-operative credit may be fostered indirectly, by the courts refusing to recognise transactions of money-lenders of less than, say, a sum of Rs. 1,000/- to agriculturists, leaving only bigger agriculturists to resort to money-lenders – co-operative societies coming to the rescue of all the smaller agriculturists.

Supply of pure and improved seeds, for which there is a growing demand, can best be done through co-operative credit societies; but departmental supply alone is insufficient. Seed-farm societies must be developed on an adequate scale and all their surplus seeds should be delivered to co-operative credit and supply societies for sale to members. A rapid multiplication of village societies (one for a group of villages) as recommended by the All-India Planning Committee on Co-operation is essential, though the target fixed is rather ambitious.

Dual-purpose societies, especially credit and supply, are more feasible than multi-purpose societies combining all functions. They may pass on produce for processing or sale to special societies located at commercial centres with wider jurisdiction and greater resources. Village societies cannot by themselves take up processing and sale ordinarily.

As for manures, apart from the supply of oil-cake and fertilizers by co-operative societies, pressure should be brought to bear on cultivators to grow green manure after the cereal crops, wherever possible, with free supply of water. Wherever possible, supplementary wells may be dug for the purpose. The use of cow-dung as fuel must be penalised. The use of nightsoil in inoffensive forms as manure should be encouraged. This is the greatest waste going on in India, while every scrap of such manure is said to be conserved and used in China and Japan.

Even if co-operative farming is not so easy to work, every endeavour should be made to persuade growers to deal as far as possible with co-operative societies for their requirements of credit, supply of seeds and manures and implements and for processing and sale of produce. In Palestine a great deal of importance is attached to these forms of co-operation by individual settlers as well as co-operative settlements. They are all very loyal to the *Hamashbir* which acts as a co-operative wholesale and the selling agency for certain types of produce.

## Minimum Price of Agricultural Produce

It is difficult to guarantee the prices of even one or two major crops. Rice is the most important crop in Madras and it governs the prices of millets and a few other local crops. An attempt may be made to assure a minimum price for it according to quality, based on the cost of cultivation, cost of living of producers and the purchasing power of masses of consumers, though the interests of both are not easy to reconcile. The Government should have complete control of imports of rice and its storage and be prepared to release imported rice at a minimum price and buy up local paddy at a maximum price. Buffer stocks must be carefully guarded against loss and it is better to store the same as paddy, not as rice.

Prices of commercial crops like cotton and groundnut are determined by forces far beyond the control of Government and are best left alone in normal times. Perishable articles like milk, eggs, vegetables and fruits are not fit objects for price control as no buffer stock can be built up by the Government or co-operatives. The demand is growing for these specialities and would grow faster if prices were brought down by increased yield and lower costs of production and marketing, for which state-aid may be given.

### Agricultural Indebtedness.

Debt Relief Legislation in Madras and the recent rise in prices have helped the bigger agriculturists more than the smaller ones. Tenants and agricultural workers not only derived no benefit from the legislation but have been hard hit by the recent rise in prices; because what little of rise in income they got was more than neutralised by the rise in prices of goods and services they have had to purchase. A positive increase in the extent of their indebtedness has been revealed by the Economist's report on Rural Indebtedness in Madras.

Co-operative credit has not been of much avail to people without land, especially to agricultural labourers. It is only a missionary agency that can help them with credit and recover it at times when they can have a little savings as at harvest time. Perpetual vigilance and active sympathy are needed, which are not forthcoming from Panchayatdars of co-operative societies. Short-term and long term co-operative credit can help the small landholders. But it would be wise in several cases to help them sell some of their fragments of land at the present ruling prices than keep the debt on for a long period of time, when prices might fall.

'Controlled credit' through the supply of seeds, manures, implements, cattle etc., can work better, if it is stipulated that the produce raised should be sold through the lending society which will pass on the produce for sale to the nearest marketing society to which it is , or should be, affiliated. Such an arrangment would help not only landed classes but also tenants, though agricultural labourers may not benefit by it.

### Minimum wages for agricultural workers.

It is a laudable aim to assure minimum wages to workers. But it is not easy to enforce payment. This has been the experience of countries which have enacted legislation, as practice lags behind law. There are long periods of unemployment on land, when labour is often prepared to work for fewer wages than prescribed by law , while in busy seasons, especially at harvest, demand for labour is in excess of supply and wages rise even when labour is not well organised. In India most farms are small and scattered, employers are petty, and labour is depressed and unorganised and therefore has little bargaining power. Just at present labour is getting more organised and vocal and making demands which petty owners of land find it difficult to concede. The agitation has succeeded more in raising the share of share-croppers than raising the wages of labourers—though this has also been achieved without effort in times of acute demand for labour.

' Forced labour ' — as found in Padiyal system in Tamil districts— has lost much of its rigour in recent times on account of facilities of

communication, and opportunities for employment in new industries and plantations. If still the system continues, it is due to the modicum of protection offered to such labour in the slack season and the totality of perquisites of all kinds available.

## Taxes on Land and Agricultural Incomes.

The abolition of the Zemindari system and its conversion into Ryotwari system will bring about uniformity in the system of taxing land. The system of land revenue assessment in the ryotwari areas is not free from defects. The following reforms are suggested :—

(i) It is certainly more correct to levy a tax on the net income than take a share of the gross produce. But this must be done not only with reference to 'Standard crops' — paddy on irrigated land and some millet on dry land — but the yield of commercial crops, their value, their cost of cultivation and net income derived should be estimated and the tax imposed according to the area under cultivation and the prices of such crops year after year.

(ii) There need be no one rate of tax payable all through a long period of 30 years during which there may be booms and depressions. The tax must vary according to net income as in the case of industrial and professional incomes. Fear of discontent at frequent changes in the amount of tax payable need no longer be entertained ; the equity of the variability of tax according to income will be appreciated. There is the difficulty of estimating cost of cultivation. But rough costing will have to be done for more than one season with the help of the Agricultural and Revenue departments.

(iii) The rate of land revenue on dry land is low in the case of commercial crops like cotton and groundnut ; it is ridiculously low in the case of lands under well irrigation, where the result of improvement effected by the land owner in the shape of wells, embankment, etc., is not charged at all for all time. It will be no bar to improvement if the exemption from taxation of the effects of improvement is restricted to a period of 30 years or 40 years (as is done in the Punjab).

(iv) The rate of tax on gardens or topes on dry or garden land might vary with the annual rental value of the different kinds of fruit trees, which now pay a low rate.

(v) The basic tax on land might be a flat rate and not exceed 12½ per cent of net income taking into aecount the ruling prices of produce and costs of cultivation. In these days of quick changes it is meaningless to take into account prices of previous twenty non.famine years for commutation.

(vi) There is no need to exempt small holdings from taxation as the basic tax of 2 annas in the rupee of net-income will not be felt oppressive. The tendency to split up holdings on inheritance should be checked.

(vii) Cesses for local bodies may be super-imposed at a rate not exceeding 12½ per cent on the basic-tax i.e. two annas in the rupee). Tangible returns in the shape of local services should convince the tax-payers of the justice of this additional levy.

(viii) A graduated income tax may be imposed — in addition to basic tax and cessess—on all agricultural net-incomes exceeding Rs. 3,000. If due accouut is taken of the investment on land and permanent improvements. and a fair return expected on such investmant in arriving at net incomes, then the tax will not be felt oppressive.

**Compost from Bagasse.** Yoshi Iwata and Toe Shiang Wu, pp. 119—26. Bagasse was treated for two weeks with lime and water, mixed with either ammonium sulphate solution or animal excrement as bacteria nutriment and piled. The piles were turned several times in a period of 170 days, by which time the material was sufficiently decomposed. NOTE:— This suggests a way for avoiding the nuisance of large quantities of cane trash left out on the fields after harvest, and a means of maintaining the humus content of the soil. Let someone invent an efficient method for picking up the trash and removing it to a convenient nearby location for composting. The artificial manure thus produced could be returned to the field between the cane rows and incorporated with the soil during ordinary cultivation. The operation will cost something but thorough experiments and engineering cultivations might show a profit. (Sugar Vol. 43, No. 7, July 1948, p. 59).

# An Agricultural Tour

*By*

**GURUSWAMI RAJU, B. Sc., Ag.**
**(Second year.)**

The annual tour of the second year students this year was confined to a fourteen days visit to the southern districts of the Province from the night of 31st October. The Blue Mountain Express steamed off with 40 budding agricultural officers, who began to feel certain that their long expected tour had actually commenced.

Nellikuppam, our first destination was reached next evening. We were comfortably put up at the "Amaravathi Palace" the owner of which received us kindly by arranging a dinner party. The Palur Agricultural Research Station was then visited where we had been given full details of various items of work done there. The total area of this farm is 55 acres. After this, the sugarcane fields, a laboratory for rearing of insect parasites, and the sugar factory of Messrs. East India distilleries and Sugar. Ltd. were visited by us.

On 3rd, Wednesday, we left Nellikuppam and we had enough time to visit the Annamalai-University on our way to Aduthurai. There, our young cameramen began to put their heads together to get a good picture and finally obtained a birds-eye-view of the University Buildings and the town from the top of the famous Sastri Hall.

Aduthurai was reached in the evening and we stayed in the rest house in the Agricultural Research Station. The Superintendent took us round the paddy fields, orchards etc. and gave us full information regarding the various strains of paddy evolved there and their distribution in the Presidency. A nice tea party was given to us by the staff of the station but unfortunately we didn't return it since we had to leave the place on the same day. Entraining at Aduthurai Railway Station in the morning, we reached Kodai Road in the evening of the 5th. Soon after our arrival we drove to Pattiveeranpatti which is about 17 miles from Kodai Road. Mr. Sountharapandia Nadar was kind enough to accommodate us in his Guest Bungalow and he took us round his extensive lands under the Grapevines, Mangoes, Paddy etc. explaining to us all the details of their cultivation and their economics. Many distinguished visitors have paid him glowing tributes. An excellent exchange of dinners were arranged between himself and ourselves. The hospitality and affability of Mr. Nadar and his sons put us at our ease and every convenience was very solicitously attended to throughout our stay there. Our pleasant stay here will always be a memorable one for our class. During our stay here we also visited a plantain garden near the riverside.

On, the 7th morning the Kodai Observatory which is about 7,800 ft. high was reached after a pleasant journey by bus. The students evinced a keen interest in seeing and knowing the workings of the various apparatus kept there, Photo-Heliograph and the Milneshaw Seisnograph were particularly very interesting. Our cameramen played an important part here in having all the beautiful new things into their small cameras. After this we returned to our halting place at Pattiveeranpatti.

Madura was reached at noon on the 8th and leaving our luggages in the station itself, we started for the inspection of the sewage farm. The luxuriantly grown guinea grass and the efficient underground drainages are worthseeing. The farm though mainly started to dispose of the sewage water and ensure the sanitation of the colony is now a source of good profit to the Madura Municipality. The farm commands an area of about 138 acres with a soil of light sandy loam, very suitable for sewage irrigation. The clear drained water from the farm collects in a tank from where it is utilized for the paddy fields and for cattle.

The next important visiting place was Koilpatti which was arrived on the 8th night. On the following morning the red soils of the Agricultural Research Station was visited by us.

On the 10th morning we went to Ettayapuram by bus and visited the lands of the Jamindar who was kind enough to receive us with a light tea party. He himself explained to us everything in a nutshell about his lands, cultivation and the working of the improved mechanical seed drill. The famous "Bharathi Memorial Hall" was also included into the cameras of our students.

The black cotton soil of the Agricultural Research Station, Koilpatti, which is within a stone's throw from the Bungalow where we stayed was visited next. The superintendent of this station explained to us the various experiments carried out in the farm, the agricultural practices of the tract and the departmental improvements effected therein. The superior variety of cotton of that tract, the practice of growing cumbu after cumbu were noteworthy features. Our activities at Koilpatti concluded with a football match on Wednesday evening against the Local High School Team which ended in a goal-less draw.

We reached Tenkasi at dusk on the 11th and with the help of the local Agricultural Demonstrator, we were accomodated in a good bungalow at Courtallem. The natural and pleasant sight of the lower Falls and the Five Falls were very much enjoyed by the party. The cameramen among us were very busy in making the falls enter into their cameras. When we just entered the mango gardens up the hills, an unfortunate accident of a snake-bite to a student, made us to retrace our steps to our lodgings. Fortunately everything went allright.

At Ellangi we met Sri Akilandam Pillai who kindly furnished us with useful information about the mango cultivation on the hills of courtallam. He gave us a good tea-party after his interesting lecture.

Saturday the 13th was spent in a long journey from Tenkasi to Coimbatore and we arrived our Headquarters on the 14th morning with a warm welcome from our collegues in the hostel awaiting us. During the tour we utilised every visiting hour to the best advantage.

The local authorities in all places were extremely kind and did their utmost not only to explain the details of work but also to help the party in the matter of lodging and boarding. We tender our grateful thanks to them for their uniform cordiality and courtesy.

# HINTS TO FARMERS

**Insect pests of sugarcane.** Sugarcane is a crop singularly free from the attacks of any serious pests in S. India. One of the most serious is the white ant, which comes immediately after planting. The use of fresh and undecomposed manure and trashes like planting of setts from the bottom portion of canes, precipitates this trouble. The admixture of crude-oil or tar-oil emulsion in the irrigation water and proper attention to manuring and the selection of setts will remedy this evil.

A few borers, commonly known as the Early shoot—and Top shoot-borers cause some amount of damage during certain years. No direct control measures can be advocated for these. The release of *Trichograma parasites* which destroy the eggs of the borers has been tried and reported succesful at Nellikuppam. The Mysore Dept. of Agriculture advocates a light earthing up as soon as the setts germinate and again about 3 weeks later.

Occasionally the cane-fly, Pyrilla also increases in enormous numbers. The young and adults of this insect have been very successfully controlled by dusting with 5 per cent Gammexane dust.

**Insect pests of paddy.** *Paddy.* Paddy is subject to the attacks of a large number of insects. One of the most serious and wide spread is the Paddy stem-borer. The caterpillars cut the ear-head stalk almost at the soil level causing 'white ears'. Usually the insects would be present even in the earlier stages when it is easily over-looked. The use of light-traps during the early hours of dark nights, will serve to destroy large numbers of the adult moths and prevent the further spread of the attack.

Another equally serious and wide-spread insect is the Rice-bug which sucks up the grain contents before it hardens. It has been recently found that dusting with Gammexene 5 per cent dust protects the crop till the grains harden.

This year, a paddy insect usually considered as of very little importance, the paddy green jassid, a dark green, wedge-shaped, small active insect developed in great numbers in certain paddy tracts and did considerable damage to the tender crop before anything could be done. It has now been satisfactorily controlled by sprays of 0·1 per cent D. D. T. in water.

The 'paddy mealy-bug' or 'soorai' is another serious insect enemy of paddy, which is becoming extremely wide-spread. Investigations are in progress to evolve satisfactory control measures. In addition, there are innumerable insects attacking paddy, some assuming greater importance in certain areas and others in other places. The use of mechanical methods of control, like netting will serve to check the trouble, if adopted early enough.

**Important Diseases of Sugarcane in S. India.** *Red rot.* The disease is caused by a fungus (*Colletotrichum falcalam*). The disease is prevalent in all sugarcane growing areas of the Province. It is difficult to detect the disease in the field in the early stages, but the following symptoms manifest themselves when the crop is in an advanced stage. The leaves wither and the stem shrivels and shrinks and the affected plants dry up.

The damage to the crop is depended on the number of clumps affected. One splitting open the cane of an affected plant, the characterestic symptom of the disease are seen viz., red blotches, with a white centre transversely elongated, are noticed in the lower internodes. A sour smell is also characterestic of the disease.

*Control measures.* The disease is propagated mainly through planting infected setts. Therefore only disease free setts should be used as planting material. As waterlogging in the fields helps the development of disease, adequate drainage facilities should be provided in all cane fields. Steeping the setts in 1% Bordeaux mixture prior to planting will reduce chances of soil infection.

*Smut.* The disease is caused by the fungus *Ustilago Scitaminea.* The smut disease of sugarcane is a limiting factor in cane production in many parts of the Province, especially in areas where ratooning is practised. The disease is easily recognised in the field. The production of long whip-like dusty black shoots, is characterestic of this disease.

The disease is chiefly propagated by planting infected setts, and a certain amount of secondary infection also occurs by the spread of infection in the fields through spores produced in the smutted shoots.

*Control measures.* The prompt removal of the entire infected clump is necessary to prevent secondary infection. Careful selection of setts, from disease free clumps, will greatly reduce chances of primary infection. Steeping the setts in 1% Bordeaux mixture will also help in reducing infection.

*Sett rot.* Caused by the fungus *Ceratostomella pardoxn.*

Setts for planting, sometimes, show a blackening, as a result of invasion of the fungus, and the germination of such setts is affected. Treatment with 1% Bordeaux mixture is effective in controlling sett rot.

**Rice diseases.** *Stem rot disease of rice—Sclerotium oryzae.* Stem rot disease of rice caused by Sclerotium oryzae has been known to occur in all paddy growing areas in the Province, but as a rule the disease affects

only a very few plants in the late stages of the crop and consequently the damage caused by it is not great. The disease was therefore considered to be of minor importance in our Province and no attempts were made to tackle it. During this year, however, the disease assumed serious proportions in some parts of Tanjore District affecting the *Kuruvai* and *Ottadai* crop and causing certain amount of damage.

**Symptoms of the disease.** The presence of small dark spots on the outer sheaths of the plant at the waterline are first indications. As the disease progresses the submerged portions begin to rot in the affected plants and the culm shrinks and ultimately collapses, causing the plants to fall over and lodge. The tillers arising from the base of infected plants die. In mild cases the disease may not kill the plants, but the earheads formed are only partially filled. The plant is sickly with yellow leaves. If a diseased culm is split longitudinally, the basal portion is found to be infected with the fungus. A weft of mycelium is produced in the hollow of the stem, and small black sclerotia* can be seen dotted all over the inner surface. The presence of sclerotia is characterestic of this disease and enables one to distinguish stem rot from other diseases like foot rot, which also affect the base of the stem. The fungus enters the plant through the base of the culm in the region which is under water and invades the tissues of the plant causing rotting of the stem.

**How does the disease spread.** The sclerotia are the fruiting bodies of the fungus. They are capable of remaining in a dormant stage for a long time, and germinate and infect the plants when conditions are favourable. Normally, when the plants are vigorous the fungus is not capable of doing much damage to the outer sheaths alone being invaded by the fungus, but when the plants are weakened by other causes such as spells of drought, inadequate manuring or lack of aeration, the fungus is able to penetrate the inner tissues and cause stem rot. In Tanjore this year, the conditions which led to the out-break of the disease would appear to be the following. (1) Inadequate water supply in the early stages of the crop, and (2) to some extent the weakening of the plants, caused by jassid infestation.

**Control measures.** Stem rot disease of rice is difficult to control. In Arkansan in America, control is effected by modification of irrigation methods. As the fungus gains entrance though the leaf sheaths in the submerged region, draining off excess water and allowing just enough water to keep the soil muddy, have been found to be effective in arresting the progress of the disease. But this may not be practicable in places where the supply of water is uncertain and is not recommended unless local conditions permit.

*Sclerotia — small dark coloured bodies of minute size but visible to the naked eye.

An application of Ammonium sulphate ½ to 1 Cwt. per acre has been found effective in stimulating the production of tillers, and overcoming the effects of the disease, in cases where the intensity of attack is not very great.

As the disease is carried over to the next season, through the stubbles in which the sclerotia are lodged, it is recommended that in all badly infected fields, the stubbles are removed and burnt after the harvest.

Hurried preparation of the land should be avoided and the field should be puddled well, and time must be allowed for the remnants of the previous crop to rot and disintegrate before transplanting is done.

## Gleanings.

**Plant Identification is an Important Service.** The New South Wales National Herbarium has received 240 duplicate specimens of South American plants to add to its collection. Many of them are species not previously represented in the collection. They include a large number of leguminous plants, and ten species of Lantana new to the Herbarium's records. Plant identification is an important service to Australian farmers. It helps to keep a check on the accidental introduction of plants known to be pests, or which may become so under Australian conditions. There is also an increasing interest in new plants, especially pasture grasses or grasses likely to be useful for the control of soil erosion. It is a curious fact that Australian farming rests on the successful cultivation of crops, fruits and grasses imported from other parts of the World. Many imported plants have done much better in Australia than in their original environment, and it is quite likely that among the specimens recently obtained from South America may be some that will eventually find a useful place, not only in the Australian Herbarium, but also among the pastures and cultivated crops of the future. (Agricultural Newsletter No. AGN/225).

**Once-a-Day Milking.** A Queensland dairy farmer has startled the Australian dairy industry by maintaining that once-a-day milking is a good commercial proposition that will reduce dairy production costs. Mr. and Mrs. C. E. Tudor, who have a Jersey stud at Gayndah, Queensland, say that from actual practice over a period of years, they have proved that a good living can be made from dairying if cows are milked once daily and fed on good pastures and crops. Stall feeding is only necessary when pastures are unbalanced, and there are no crops. With twice-a-day milking, so the Tudors, a farmer spends about seven hours daily with his cows. He does not have time to grow all the feed he needs and has to pay high prices for lucerne and grain. Under their scheme, the cows are finished in the morning and the rest of the day is left free for farm-work. There is little difference in the butterfat yield of a cow with once-a-day milking. Milk supply is a little less but this is offset by the amount given over the whole lactation period, which is extended. The Tudors milk freshly-calved cows twice-a-day for six weeks, then put them on to once-a-day milking.

**New Potato Does Well.** Monak, a new variety of potato bred by Mr. J. G. Carrol plant-breeder of the New England Experiment Farm, Glen Innes, New South Wales, has done well in official trials, yielding two tons a acre more than Factor and Katahdin, the varieties usually grown in the district. The trial crop was planted on July 21, 1948, and harvested on November 10. A complete fertilizer mixture was supplied at the same rate to all plots, and all varieties had to contend with a dry spring. Yields of varieties in the trial, calculated to the nearest half ton were:—

| | *Tons.* |
|---|---|
| Monak | 8½ |
| Maunguy | 7½ |
| Factor | 6½ |
| Sequoia | 6½ |
| Sebago | 6½ |
| Moona | 6 |
| Aussie | 5½ |
| Katahdin | 5½ |
| Seedling 2511 | 5½ |
| Seedling 2507 | 4½ |

Monak is a cross between Pontiac and Katahdin. It matures a little later than Factor. It has large round white smooth-skinned tubers with shallow eyes and is blight-resistant. Moona, another new variety in the trial, is a cross between Factor and the American variety Saranac. With Monak and seedlings 2507 and 2511, it was bred at Glen Innes by Mr. Carrol.

**Scientists Tackle Citrus Problem.** Australian research workers are tackling the problem of finding a practical method of ridding citrus orchards of boron, where it is believed to be present in excessive and toxic quantities. Many citrus trees in the Mildura irrigation area of north-western Victoria have displayed an affection of the leaves known as 'tip-burn'. For a long time this was thought to be a disease. Then it was supposed that 'tip-burn' was caused by salt in the soil, brought to the surface by continued irrigation. This salt theory has not yet been disproved, and investigations are continuing both at Mildura and on the Murrumbidgee Irrigation Area, in New South Wales. Meanwhile, an alternative explanation has been suggested by the discovery that boron in toxic quantities is present in the soil of places where 'tip-burn' is prevalent, and where an almost total absence of soluble salts proved that salting was not causing the symptoms. If this is confirmed by further investigation, it may be necessary to devise some method of neutralising or 'fixing' the boron in the soil. The alternative would be the long and costly process of developing citrus strains with a high resistance to boron in abnormal quantities. (Agricultural Newsletter: No. AGN. 224).

**Bananas Now in the Can.** Queensland banana growers are looking forward to increased production and prosperity now that the fruit marketing cannery at Banyo, Queensland, Australia, has produced canned bananas. Following extensive experiments, the factory has developed a method of processing which produces canned bananas that are not affected by bacteriological action and retain practically 100 per cent of their natural colouring and characterestic flavour. Previously bacteriological action and colour deterioration had prevented canning. A trial pack of 8,000 dozen tins of bananas has been placed on the market to test public demand. Successful canning of bananas will mean stabilisation of prices and increased demand as excess supplies can be taken off the fresh fruit market. Queensland, where the canning process has been developed, grows only 6,00,000 bushels of bananas a year, a small proportion of the total Australian crop. The most productive area is the north coast of New South Wales, where 4,600 farmers between Tweed Heads and Nambucca River, have total plantation areas of 30,000 acres from which they harvest 2,500,000 bushels of bananas a year. Besides these, they grow tropical fruits—pineapples, pawpaws (paw pia), passion fruit, avocados—with side crops of beans, tomatoes, peas and sweet potatoes which altogether return them £A-3,500,000 annually. (Agricultural Newsletter. No. AGN. 220).

**Apple-thinning Hormone Sprays.** Promising results are being obtained in Australia from experiments with sprays to regulate or thin apple and par crops. Trials carried out by the Horticultural Division of the New South Wales Department of Agriculture during the last two seasons have used various sprays containing the hormone preparation 2, 4—D, and the commercial product Methoxone. These 2, 4—D sprays gave the best results, particularly with Granny Smith, Democrat and Delicious apple trees. Depending on the strength of the spray, either all the young fruit was removed or all fruit from weak spurs removed, leaving fruit, often thinned out to singles, on strong spurs. In rare instances, the spray killed the weakest spurs but this loss of weak spurs which hardly ever set fruit is not considered a disadvantage. Where the spray was used to remove fruit from the tops of Granny Smith trees, fuit on the lower parts of the trees was undamaged and was exceptionally well-grown and uniform in size. Thinning effected by sprays applied in 1946 promoted blossoming in 1947. Australian apple and pear growers have been warned by agricultural authorities that tests are still in early stages and recommendations are only made for experimental purposes. They emphasise that the strength of sprays must be regulated to the variety and vigour of individual trees, and that pears and sensitive apple varieties require sprays of low strength, which means that growers who decide to use the hormone spray method of thinning must be prepared to carry out a certain amount of experimental work in their own orchards or consult district fruit officers. [Agricultural Newesletter: No. AGN/225].

**New Cool Chamber for Eggs, Fruit & Vegetables.** A cool chamber which keeps eggs, fruits and vegetables fresh and odourless for periods of months, is an Australian invention, now being marketed in Melbourne, Victoria. Inventor is Mr. V. Holmquist of Boondarra Road, East Street, Kilda, who is a specialist in the commercial use of activated carbon. The new cool chamber requires only two gallons of water daily, and once installed there are no other costs of upkeep. The principles of the invention are the use of actlvated carbon to absorb food odours with water circulation and air currents maintaining the food products in good condition. The characterestics of activated carbon enable it to absorb carbon dioxide gas which is given off by fruit in storage. The substance used is actually activated charcoal, processed by the marketing company for use in the cool chambers.

In combination with flues built into the chamber and the walls, backed with carbon, all odours from fruit and vegetables are absorbed, and the food products are kept fresh and in a natural state. The cool air which passes through the watered carbon circulates throughout the chamber, and assists in the general operation. No expensive upkeep is required for the domestic type of cool chamber which is now being marketed, and the

water, a gallon or so, is replenished each day. A system of syphons at the top of the chamber provides for the continual water circulation through the built-in carbon. The cool chamber, which is built of galvanised iron, is 27 inches long, 21½ inches wide and 40 inches deep, and sells at £A 25. It is intended to be placed outside the house, so as to gain the full benefit of the air circulation. Tests conducted by the inventor show that oranges and other citrus fruits remain fresh for periods of up to six months. Bread will keep fresh for a week, and vegetables and milk do not use their qualities after months of storage.

Larger units 6 ft. x 6 ft. x 6 ft. 6 ins., are being extensively used by poultry farmers in Victoria for storing eggs. This model is sold at £A 100. A report by the inspector's section of the Australian Egg Board states that the claim made by the manufacturing company that eggs could be held for long periods in association with commodities like citrus fruit, onions and vegetables, had been proved by experimental tests. After four months' observation it was found that the eggs (of export quality) had not absorbed any odour or flavour. To meet the requirements of citrus growers and orchardists generally, the company also markets a large unit 12 ft. x 8 ft. x 8 ft., at £A 300. It is claimed that the results are an improvement upon refrigeration, as the fruits are not affected in their taste qualities, after long periods of storage—a result which the company claims cannot be obtained by usual refrigeration. A fourth application of the principles of the invention is a very small cool chamber which can be fitted into the orthodox Ice-box to absorb the usual food odours through the activated carbon. [Agricultural Newsletter No. AGN/226.]

## Extract

**Sugarcane—Pineapple disease of sugarcane (Ceratostomella paradoxa)** is the major cause of failure of cane sets to germinate in Mauritius, often causing serious economic losses, especially under drought conditions and in cooler uplands. Experiments by treating the cane sets with organic mercury compounds before planting, have given satisfactory results. The ends of the cane sets were dipped into a 1% or 2% solutions of organic mercury compounds like Aretan, Agrosan, Verdasan, Abavit, or Ceresan and planted them in infected soils. Some cane sets were dipped in dry lime. Some of the plots were irrigated and a few were not irrigated. For control untreated cane sets were also planted. When germinated plants were examined later, untreated plants showed 68·87% infection, whereas 1% solution treated plants showed not more than 10% infection Aretan was the best of all the organic mercury fungicides used. A 2% solution of Aretan treatment reduced the infection to 3·67% and in all cases a 2% solution of the organic mercury compound was better than 1% solution Treating the ends of the cane sets with lime did some good and the infection was still 29·67%. The experiments further showed that the disease was especially prevalent under dry conditions. The infection was 42% less on the irrigated than on the unirrigated controls. (Sugar Vol. 43, No. 7, July 1948, p. 52).

# Agricultural College and Research Institute Library, Lawley Road, Coimbatore.

## MONTHLY LIST OF ADDITIONS FOR DECEMBER, 1948

| | | |
|---|---|---|
| 1. | Association of British Insecticides: Directory for 1948 | 1948 |
| 2. | Association of Vitamin Chemists: Methods of Vitamin Assay | 1947 |
| 3. | BLAU (Greda): World Fibre Survey | 1947 |
| 4. | BOWER (F. O.): Botany of the Living Plant Edn. 4. | 1948 |
| 5. | BURREL (R. C.): Organic Chemistry for Students of Biological Sciences | 1948 |
| 6. | CHANDRASEKHARA IYER (S. N.) & PARTHASARATHY (S. V.): Handbook of Botany for India by K. Rangachari, Revised Edn. 4 | 1948 |
| 7. | CHOUDHURY (Sudhir): Plant Diseases and their Causes | 1948 |
| 8. | COLINS (Edward C.): Elements of Geneties | 1947 |
| 9. | COMMON-WEALTH Agricultural Bureau: List of Research Workers in the British Commonwealth | 1947 |
| 10. | COMMONWEALTH Ecommic Committee: Daiiy Produce | 1948 |
| 11. | ———————— Plantation Crops | 1948 |
| 12. | ———————— Vegetable Oils and Oilseeds | 1948 |
| 13. | COOK (M. T.): Virus and Virus Diseases of Plants | 1947 |
| 14. | DUMMIER (E. F )& HEFLEBOWER (R. B.): Economics with applications to Agriculture Edn. 2. | 1940 |
| 15. | FAWCETT (H. S ): Citrus Diseases and their Control Edn. 2. | 1936 |
| 16. | GOLDSCHMIDI (Richard): Physiological Geneties | 1938 |
| 17. | GUPTA (Satish Chandra Das): Cow in India, 2 Vols. | 1945 |
| 18. | HARVEST Gold—Caltex petroleum products | 1948 |
| 19. | HOAGLAND (D. R.): Inorganic Nutrition of Plants | |
| 20. | INDIAN SUGAR INDUSTRY MANUAL for 1947—'48 | 1948 |
| 21. | ISLEY (DWIGHT): Methods of Insect Control P. I and P. II | 1948 |
| 22. | JATHAR (G. B.) & BERI (S. B.): Elementary Principles of Economics Edn. 5 | 1948 |
| 23. | JOHNSON (B. C.): Methods of Vitamin determination | 1948 |
| 24. | KOMHATKAR (V. Y.): Reconstruction of Indian Agriculture | 1946 |
| 25. | MANIAN (E. V. S.): Handbook of Textile Industry | 1948 |
| 26. | MURNECK (A. E.) & WHYTE (R. O.): Vernalisation—a symposium | 1948 |
| 27. | NAUDE (C. P.): Production of Nicotine sulphate from Tobacco waste | 1947 |
| 28. | ONTARIO Agricultural Department—Annual Report for 1946 | 1947 |
| 29. | PIGOU (A. C.): Income | 1948 |
| 30. | ———————— Socialism vs. Capitalism | 1948 |
| 31. | RAMIAH (K.): Rice in Madras | 1947 |
| 32. | RILEY (Herbert Barkes): Introduction to Cytogenetics | 1947 |
| 33. | SAKSENA (R. D.) Handbook of Crop Pests | 1948 |
| 34. | SHAH (K. J.) Communications | 1948 |
| 35. | ———————— Engineering Industries | 1948 |
| 36. | ———————— Industrial Finance | 1948 |
| 37. | ———————— Chemical Industries | 1948 |
| 38. | ———————— National Planning: Principles and administration | 1948 |
| 39. | ———————— Rural and Cottage Industries | 1948 |
| 40. | ———————— Soil Conservation | 1948 |
| 41. | SUMMERS (E. M.) etc.: Mosaic of Sugarcane in U. S. | 1948 |
| 42. | TICKELL (F. G.): Examination of Fragmental Rocks, Edn. 3 | 1948 |
| 43. | WHITEHEAD (Stanley B.): Gardners Earth | 1945 |
| 44. | WHYTE (R. O.): Farming for Industry | 1948 |
| 45. | WOODMAN (H. E.): Rations for Livestock Edn. 11 (eleven) | 1948 |
| 46. | WRENCH (G. T.): Reconstruction by way of the soil | 1946 |

# Crop and Trade Report.

**Cotton Raw in the Madras Province.** The Receipts of the loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1948 to 7th January 1949 amounted to 355,946 bales of 400 lb. lint as against an estimate of 283,700 bales of the total crop of 1947—'48. The Receipts in the corresponding period of the previous years were 406,165 bales. 504,288 bales mainly of pressed cotton were received at spinning mills and 33,171 bales were exported by sea while 115,668 bales were imported by sea mainly from Karachi and Bombay.

**Statistics—Crop—Sugarcane—1948—Intermediate—condition report.** The condition of the sugarcane crop is generally satisfactory in all the districts of the Province except in Anantapur, Chingleput, North Arcot, Salem and Ramnad Districts where the crop has been affected adversely due to inadequate rains during the growing period and the yields are expected to be below the normal. The crop had a set back in the early stages due to the attack by insect pests in parts of the Vizagapatam District but has since revived.

2. The wholesale price of jaggery per imperial maund of 82-2/7 lb. (equivalent to 3,200 tolas) in the important market centres in the Province on the 18th December 1948 was Rs. 17—13—0 in Erode, Rs. 17—10—0 in Tiruchirapalli, Rs. 15—13—0 in Salem, Rs. 14—10—0 in Vizagapatam, Rs. 13—1—0 in Coimbatore, Rs. 12—8—0 in Mangalore, Rs. 12—6—0 in Cuddalore and Vellore, Rs. 10—15—0 in Vizianagaram, Rs. 10—13—0 in Adoni, Rs. 10—11—0 in Rajahmundry, Rs. 9—7—0 in Chittoor, Rs. 8—10—0 in Bellary and Rs. 8—4—0 in Kakinada. When compared with the prices published in the last report i.e., those which prevailed on 6th November 1948, these prices reveal a rise of approximately 20 per cent in Salem, 16 per cent in Vellore, 14 per cent in Chittoor, 10 per cent in Bellary, 9 per cent in Tiruchirapalli, 8 per cent in Cuddalore and 7 per cent in Vizagapatam and a fall of approximately 30 per cent in Adoni, 29 per cent in Coimbatore, 9 per cent in Kakinada and 7 per cent in Rajahmundry, the prices remaining stationary in Vizianagaram, Erode and Mangalore.

**Statistics—Crop—Castor—1948—First and final report.** The average area under castor in the Madras Province during the five years ending 1944—'45 represents 18·2 per cent of the total area under castor in India. The area under castor in the Madras Province upto 25th November 1948 is estimated at 230,800 acres. When compared with the area of 230,500 acres estimated for the corresponding period of last year, it reveals an increase of 0·1 per cent. The estimate of last year was less than the actual area of 240,700 acres by 4·1 per cent. The crop is grown on a large scale in the districts of Guntur (23,900 acres), Kurnool (33,300 acres), Bellary (18,100 acres), Anantapur (57,400 acres), Nellore (43,200 acres) and Salem (17,200 acres). The area estimated for the current year is the same as that of last year in the districts of Kurnool, South Arcot, Ramnad, Malabar and South Kanara. An increase in area is estimated in the districts of East Godavari, Krishna, Bellary and Tanjore and a decrease in area in the other districts of the Province due mainly to want of timely rains. The decrease in area is marked in Anantapur District (—1,600 acres), Cuddaph District (—2,400 acres), Nellore District (—2,800 acres) and Salem District(—1,500 acres).

The yield per acre is expected to be normal in the districts of East Godavari West Godavari, Krishna, Nellore, South Arcot, Chittoor, Madurai, Ramnad, Tirunelveli and Malabar and below the normal in the other districts of the Province. The seasonal factor for the Province as a whole is estimated at 94 per cent for the normal. On this basis, the total yield is estimated at 21,200 tons as against 21,800 tons estimated for the corresponding period of last year. The wholesale price of castor seed per Imperial maund of 82-2/7 lbs. or 3,200 tolas, as reported from important market centres on 17—12—1948 was Rs. 24—13—0 in Nandyal, Rs. 23—1—0 in Guntur, Rs. 21—1—0 in Vizianagaram and Rs. 14—2—0 in Bellary. When compared with the prices which prevailed on 20—12—1947, these prices show an increase of 15 per cent in Nandyal and 4 per cent in Bellary and a decrease of 13 per cent in Vizianagaram and 6 per cent in Guntur.

# Weather Review—For December 1948.

## RAINFALL DATA.

| Division | Station | Actual for month in inches | Departure from normal in inches | Total since January 1st in inches | Division | Station | Actual for month in inches | Departure from normal in inches | Total since January 1st in inches |
|---|---|---|---|---|---|---|---|---|---|
| Orissa & Circars. | Gopalpore | Nil | —0·5 | 36·0 | South. | Negapatam | 9·2 | —1·7 | 44·8 |
| | Calingapatam | Nil | —0·5 | 33·1 | | Aduturai* | 3·2 | —2·1 | 24·3 |
| | Vizagapatam | 0·6 | +0 1 | 29·7 | | Pattukottai* | 3·0 | —1·6 | 28·0 |
| | Anakapalle* | Nil | —0·9 | 35·5 | | Madurai | 1·3 | —0·7 | 22·9 |
| | Samalkot* | 0·4 | +0·1 | 40·7 | | Pamban | 9·8 | +2·2 | 32·3 |
| | Kakinada | 0·4 | —0·3 | 49·7 | | Koilpatti* | 0·3 | —2·8 | 36·2 |
| | Maruteru* | Nil | —0·6 | 33·4 | | Palamcottah | 0·7 | —3·1 | 30·4 |
| | Masulipatam | 0·3 | —0·3 | 37·9 | | Amba-samudram* | 3·2 | —4·5 | 42·8 |
| | Guntur* | ... | ... | ... | | | | | |
| | Agri. College, Bapatla | 0·5 | —0·2 | 33·1 | West Coast. | | | | |
| | Veeravanam (College Farm) | ... § | ... | 32·8 | | Trivandrum | 0·4 | —2·0 | 82·6 |
| | | | | | | Cochin | 0·8 | —0·8 | 109·2 |
| | | | | | | Calicut | 0·6 | —0·4 | 119·9 |
| Ceded Dists. | | | | | | Pattambi* | Nil | —1·8 | 95·8 |
| | Kurnool | Nil | —0·2 | 22·4 | | Taliparamba* | 0·7 | —1·0 | 139·6 |
| | Nandyal* | Nil | —0·4 | 27·8 | | Nileshwar* | 0·1 | —1·8 | 140·1 |
| | Hagari* | Nil | —0·3 | 22·5 | | Pilicode* | 2·1 | —0·5 $ | 145·3 |
| | Siruguppa* | Nil ‡ | —0·1 ‡ | 21·6 | | Mangalore | Nil | —0·5 | 120·6 |
| | Bellary | Nil | —0·1 | 22·8 | | Kankanady* | Nil | —0·6 | 117·9 |
| | Rentichintala | Nil | ... | 26·6 | | | | | |
| | Cuddapah | Nil | —0·8 | 22·8 | Mysore & Coorg. | | | | |
| | Anantharajpet* | 1·7 | —0·6 | 25·1 | | Chitaldrug | Nil | —0·5 | 32·1 |
| | | | | | | Bangalore | 0·2 | —0·2 | 39·4 |
| Carnatic. | Nellore | 2·5 | —0·4 | 35·8 | | Mysore | 0·1 | —0·4 | 29·4 |
| | Buchireddi-palem* | 2·4 | —1·1 | 30·6 | | | | | |
| | Madras | 1·7 | —3·7 | 34·1 | Hills. | Mercara | 0·4 | —0·3 | 143·4 |
| | Tirurkuppam* | 1·3 | —7·2$ | 39·0 | | Kodaikanal | 3·7 | —1·5 | 73·8 |
| | Palur* | 3·1 | —2·7 | 61·8 | | Coonoor* | 11.1 | +4.9 | 79·8 |
| | Tindivanam* | 1·8 | —2·5 | 31·7 | | Ootacamund* | ... | ... | ... |
| | Cuddalore | 2·6 | —4·9 | 42·8 | | Nanjanad* | 1·2 | —0·6 | 73·1 |
| Central. | Vellore | 0·5 | —2·1 | 30·5 | | | | | |
| | Gudiyatham* | 0·2 | —2·2 | 27·8 | | | | | |
| | Salem | 0·4 | —0·6 | 31·8 | | | | | |
| | Coimbatore (A. C. R. I.)* | 0·7 | —1·3 | 20·0 | | | | | |
| | Coimbatore (C. B. S.)* | 0·6 | —1·6 | 23·1 | | | | | |
| | Coimbatore | 1·1 | —0·3 | 19·5 | | | | | |
| | Tiruchirapalli | 0·5 | —2·3 | 29·4 | | | | | |

*Note :—* (1) * Meteorological Stations of the Madras Agricultural Department.

(2) Average of ten years data is taken as the normal.

(3) $ Average of six years for Tirurkuppam, and seven years for Pilicode.

(4) § The actual rainfall was 0 02".

(5) ‡ Taluk office rainfall being Nil for the month

(6) ... Figures not available.

## Weather Review for December 1948.

A number of mild western disturbances occurred near Punjab and Rajputana.

On 31—12—1948 conditions became markedly unsettled in the extreme South-West Bay. An active western disturbance was found moving across North-West Punjab.

The weather throughout the country was practically dry.

In the Madras Presidency weather was almost dry during the first half of December 1948 except for the isolated mild showers in certain interior parts of Andhradesa, Tamilnad and Kerala. North-East Monsoon became active on 19—12—1948 along and near the Coromandal Coast. On the next day it was active throughout the Tamilnad. Then, again the weather became dry. Towards the end of the month, there happened to be some showers along South Coromandal Coast. But on the whole, though the North-East Monsoon started well, the total precipitation was poor with long spells of dry weather with the result that the crops dependent on rains including rainfed paddy suffered very much.

In most of the places the night temperature happened to be less than the normal particularly in the first half of the month.

The note-worthy falls in the Madras Province are as detailed below :—

| S. No. | Place. | Date. | Rainfall in inches. |
|---|---|---|---|
| 1. | Nellore | 2—12—1948 | 1·5 |
| 2. | Madura | 8—12—1948 | 1·0 |
| 3. | Negapatam | 18—12—1948 | 4·4 |
| 4. | Kallakurichi | 21—12—1948 | 1·7 |
| 5. | Cuddalore | ,, | 1·2 |
| 6. | Pamban | 28—12—1948 | 2·2 |

M. B. V. N &. C. B. M.

## OBITUARY.

We regret to record the death of K. V. Suryanarayanamurthy, who was lastly Marketing Assistant at Kakinada, on 19—1—1949 at his residence in Anakapalle at the early age of 27, after a prolonged suffering from Tuberculosis. He was a bright student of the Agricultural College, Coimbatore. He took his B. Sc. (Ag) degree in 1943. He served for a short time in the Nizam's Sugar Factory and later he joined the Agricultural Department first as Assistant in Chemistry at Coimbatore.

We offer our heartfelt sympathies to the members of the bereaved family.

# Departmental Notifications

## GAZETTED SERVICE—POSTINGS AND TRANSFERS

| Name of Officers | From | To |
|---|---|---|
| Sri Govinda Rao, P. | Lecturer in Mycology, Bapatla, | Plant Protection Officer (Mycology) Bapatla |
| „ Gopala Unnithan, M. | D. A. O., Calicut, | Assistant Marketing Officer, Coimbatore |
| „ Gopala Menon, E. R. | Assistant Entomologist (Teaching) Coimbatore, | Plant Protection Officer (Entomology), Coimbatore |
| „ Krishnan, B. S. | D. A. O., Under Training, Guntur, | D. A. O., Ellore |
| „ Krishna Menon, K. | Assistant Mycologist (Erogt Scheme) Ootacamund, | Plant Protection Officer (Mycology) Coimbatore |
| Mohammad Basheer Sahib Bahadur, | Gazetted Assistant Lecturer in Entomology, Bapatla, | Lecturer in Entomology, Bapatla |
| Sri Mukundan, M. | D. A. O., Under Training, Calicut, | D. A. O., Calicut |
| „ Rama Mohan Rao, A. | (On leave), | D. A. O., Chittoor |
| „ Ramiah, P. V. (Rao Bahadur) | (On leave), | Principal, Agricultural College, Bapatla |
| „ Srinivasa Ayyangar, C. R. | Principal, Agricultural College, Bapatla, | Headquarters Dy. D. A., (Research) Madras |
| „ Subramania Mudaliar, V. K. | Headquarters Dy. D. A., Madras, | Regional Dy. D. A., Vellore |
| „ Subbiah, M. S. | (On leave), | Assistant Entomologist (Teaching) Coimbatore |
| „ Santhanam, K. | D. A. O., Under Training at Tanjore, | D. A. O., Cuddalore |
| „ Satagopan, V. | D. A. O., Cuddalore, | Assistant Marketing Officer, Madras |
| „ Thirumala Rao, V. | Lecturer in Entomology, Bapatla | Plant Protection Officer (Entomology) Bapatla |

## SUBORDINATE SERVICE—APPOINTMENTS

The following candidates are appointed to the posts shown against each :

| Names | To |
|---|---|
| Sri Chandrayya Naidu (Nellore) | A. D., Rapur |
| „ Kanakaprasada Rao, K. (W. Godavari) | F. M., Cotton Breeding Station, Coimbatore |
| „ Koteswara Rao, K. (Krishna) | A. D., Avanigadda |
| „ Koteswara Rao, T. (Krishna) | A. D., Pattikonda |
| „ Ramasubbiah, K. (Bellary) | Cotton Assistant, Adoni |
| „ Rama Rao, P. V. (E. Godavari) | A. D., Chodavaram |
| „ Rangamannar, (Bellary) | A. D., Rayadurg |
| „ Subba Rao, P. (Guntur) | A. D., Cheepurupalle |

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| Mr. Ali Hyder Sahib, R. | A. D., Anakapalle, | A. D., Kudligi |
| Sri Ambikacharan, | A. D., Venkatagiri, | P. A., to D. A. O., Madras |
| „ Ananthapadmanabha Pillai, R. | D. A. O., Chittoor, | P. A., to D. A. O., Vellore |
| „ Ayyaswami Ayyar, T. V. | On leave | Srivaikuntam |

| Names | From | To |
|---|---|---|
| Sri Antoy, J. S. C., | A. A. D., Tirukoilur, | A. A. D., Papanasam |
| ,, Balasubramanian, R. | Plant Quarantine Inspector, Shenbaganur, | A. D., Melur |
| ,, Dhamodhara Prabhu, M. | A. D., Mangalore, | A. D., Puthur |
| ,, Duraiswami, K. N. | A. D., Attur, | A. D., Salem |
| ,, Koteswara Rao, D. | Assistant Mycology, Coimbatore, | Assistant in Mycology, Bapatla |
| ,, Kutti Mudali, K. S. | A. D., Salem, | A. D., C. M. P., Project Area, Tanjore |
| ,, Lakshmipathi, S. | A. D., Chittoor, | A. D., Punganur |
| ,, Narasimha Rao, T. L. | ... | Assistant in Entomology, Anakapalle |
| ,, Nagaeswara Sarma, D. | A. D., Tiruchengode, | A. D., Kandakur |
| ,, Narayana Reddy, M. S. | Assistant in Cotton, Adoni, | A. D., Nandyal |
| ,, Narasimha Reddy, R. | A. D., Pulivendla, | A. D., Proddatur |
| ,, Narayana Reddy, B. | A. D., Vayalpad, | A. D., Ananthapur |
| ,, Pitchayya, B. | Assistant in Paddy, A. R. S., Tirurkuppam, | F. M., Agricultural College, Bapatla |
| ,, Rama Rao, M. V. | A. D., Sompeta, | A. D., Kurnool |
| ,, Radhakrishna Rao, K. | Assistant in Entomology S. R. S., Anakapalle, | Plant Quarantine Inspector, Shenbaganur |
| ,, Rama Rao, M. | A. D., Kudligi, | A. D., Rapalle |
| ,, Ramasomayajulu, | A. D., Chodavaram, | F. M., A. R. S., Samalkot |
| ,, Rama Rao, S. | (On leave), | A. D., Gudur |
| ,, Rama Rao, V. | A. D., Nellore, | A. D., Venkatagiri |
| ,, Raghavulu, G. V. | (On leave), | Marketing Assistant, Nagpur |
| ,, Sankaranarayanan, C. | F. M., A. R. S., Koilpatti, | A. D., Tiruchengode |
| Mr. Syed Mohammad, D. A. | (On leave), | A. D., Gingee |
| Sri Sundaram, N. V. | Coconut Nursery Assistant, Palur, | Assistant in Mycology, Coimbatore |
| ,, Sanjiva Shetty, K. | P. A., to D. A. O., Coimbatore, | A. D., Mangalore |
| Mr. Syed Sheriff, | A. D. C., M. P., Project area, Tanjore, | A. D., Mudukulathur |
| Sri Subramania Chetty, M. | Special A. D., Sugarcane Scheme, Karur, | F. M., A. R. S., Koilpatti |
| ,, Satyanarayana Rao, G. | P. A., to D. A. O., Madras, | A. D., Palmaner |
| ,, Sheik Hussain Sahib, | P. A., to D. A. O., Nellore, | A. D., Nellore |
| ,, Subramanian, T. R. | F. M., C. B. S., Coimbatore, | Assistant in Entomology, Coimbatore |
| ,, Sitarama Raju, D. | Assistant in Botany (on leave), | Assistant in Botany, Bapatla |
| ,, Sithalinga Reddy, S. | A. D., Punganur, | Assistant in Mycology, Coimbatore |
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| ,, Veerabhadra Rao, K. | D. A. O., Nellore, | P. A., to D. A. O., Nellore |
| ,, Venkataraghava Raju, N. | A. D., Ananthapur, | A. D., Attur |
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